VISITS IN THE PROVINCES.

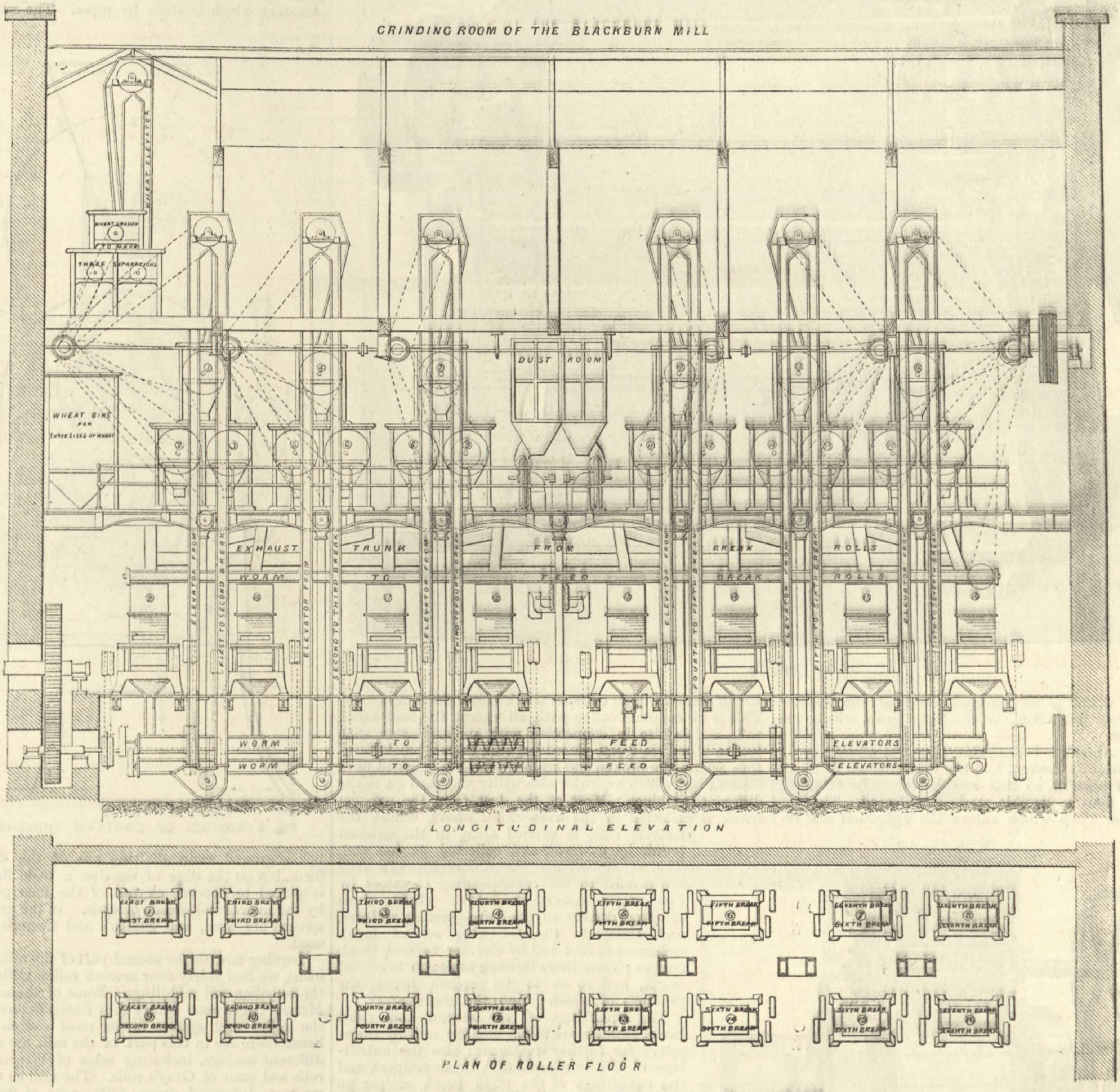
MESSRS. GREENWOOD'S MILL, BLACKBURN.

IN October last Messrs. John Greenwood and Son, of the Blackburn Mills, Blackburn, invited a large party of operative millers and others interested in milling to inspect the new automatic roller mill plant erected for them by Mr. J. Harrison Carter, of Mark-lane. This mill is one of the largest, if not the largest, on the roller mill system in this country, and will turn out 8600 sacks of flour per week. The mill has been long established on the old system, and has had the best machinery of its kind. Roller milling has made incomparably greater strides in the North of England than in the South, and it is remarkable that not only do large millers adopt the system because a higher quality of flour is obtained by it and a somewhat greater return made, but because the public demand now enforces its adoption. Millers have found themselves driven to its adoption by loss of trade, and it may be hoped that it will not be long before London, which is supplied with bread inferior to that of any large town in England, will show that it means to have a white, pure, clean loaf at a price as low as it can be obtained in Lancashire. A transverse section of Messrs. Greenwood's mill is given at page 41. At the time of the visit, one-half only of the grinding machinery had been substituted by roller mills at A, the other at B; next the proposed new half on the engraving above referred to as undergoing the change.

The mill, with one half converted, is now doing about thirty sacks per hour with about 358·62 indicated horse-power, whilst the old stone mill used to indicate 600 horse-power, for forty sacks per hour, which shows a considerable decrease of power for the roller milling system, although the power required for this plant is larger than usual, owing to the heavy gearing and shafting. Yet the loss of power from friction, at present upon one-half of the mill, will, when the other half is completed, be distributed upon the whole mill, which will give a far more satisfactory result. The engine is a large compound beam by the Lowmoor Company, the compounding cylinder having been added since it was made about twenty years ago. The grinding room of the mill contains the break rolls and scalpers with their respective elevators. There are sixteen of Carter's break roller mills, which break and scalp the wheat for the reduction and re-dressing part of the mill, which has thirty-four smooth roller mills. The relative positions of the different machines is seen from section, Fig. 1, page 41, and the section and plan, Figs. 2 and 3. Referring now only to that half of the mill which is on the right of a centre line through the chimney stack and stairs, page 41, it will be seen that there is above the letter A in the middle part of the building a double row of mills, including all from the first to the seventh break rolls, which are divided as follows:—The whole of No. 1 and half of No. 9 for first break; the whole of No. 10 and half of No. 9 for second break; the whole of Nos. 2 and 3 for third break; the whole of Nos. 4, 11, 12, for fourth break; the whole of Nos. 5, 6, 13 for fifth break; half of No. 7, the whole of Nos. 14 and 15 for sixth break; half of No. 7, the whole of Nos. 8 and 16 for seventh break. The first break machines have three different flutings, eight flutes per inch for the coarsest, ten for the medium, and twelve for the finer sized wheat. Then the second breaks have 12 flutes per inch; the third, 14; the fourth, 16; the fifth, 18; the sixth, 20; and the seventh, 24 per inch. Above them are the scalpers, which divide the chop from the broken wheat, and to make a thorough separation, there being three machines for each break from Nos. 1 to 6, the hexagon cylinders are covered with wire according to the different breaks, and the lengths of which are 8ft. by 2ft. 8in. These mills are placed as shown in the part plan, and some idea of the order of the operations may be gathered from the inscriptions on each of these mills in plan, and from what has already been said, but we are not at liberty to give a complete plan, known as a *modus operandi*, by which the path taken by the corn in its passage from the cleaning machine to the final several delivery spouts. This process chart is, of course, not the same for all mills, and the larger the quantity of machinery adopted the more complex is the problem of arranging the complete circuit of the material operated upon the various machines and their connection. To milling engineers the engravings we give are interesting, as showing to a considerable extent the arrangement of the machinery of very large size, working so successfully that the owners are so satisfied with the results as to quality, quantity of flour produced, and the price at which it is made, that they are doubling this extensive plant and removing what in many places would still be considered excellent machinery, including fifty-two pairs of stones. All the roller mills are of the Carter design. Those with two pairs of independent rolls are shown by Figs. 4, 5, and 6, whilst the three-high roller mill is illustrated by Figs. 7 and 8—see THE ENGINEER, May 20th, 1881.

On entering Messrs. Greenwood's mill, the whole of the wheat first passes through large sieves, where all large impurities, such as straw and the many other things that get mixed up with wheat on its way from the thrashing machine to and from warehouses, ships' holds, and dock granaries to the mill, are removed. The wheat from this time is lost to the visitor, until, having passed through scrubbers and dusters, it reaches a long trough at a high elevation in the mill, in which works a strong worm conveyor. As the wheat enters this trough a small stream of water runs into it. The water so mixed with it is very small in quantity when compared with the weight of wheat with which it is mixed, and though it helps in the removal of the adherent dirt, it is to a great extent absorbed by the wheat without making it feel appreciably damped as it leaves this long trough conveyor. During its long passage in this trough the wheat not only receives the translating movement, but is in such continuous self-rubbing and worm-rubbed movement tumbled over and over itself, that this part of its history in the mill is one of very efficient cleaning, and apart from the separation of dirty, heavy dust, which leaves it in its passage along the trough, it is in a condition to give up most readily any dirt or dust carried with it from this conveyor. There is no doubt that these screw conveyors consume a good deal of power as compared with belt conveyors, but the work done in cleaning the wheat is no doubt worth more than the cost of the power consumed. An extension of this cleaning action in the conveyor suggests itself as a possible development which might render a previous cleaning operation, or smutting, unnecessary. To one accustomed to the "that-will-do" policy of the older modes of milling, a visit to one of these new mills, in which trouble is taken to clean the wheat before grinding it up into flour, gives rise to uncomfortable reflections concerning the quantity and variety of dirt which must have found its way into the puddings and bread. It is well that with the greater use of foreign, and therefore far-travelled and dirtied wheat, the eyes of millers have been opened to this dirtiness, and in a well-appointed mill there is not much dirt now finding its way into flour. In flour from mills still working on the old system, with nothing between wheat-receiving bins and the sudden death millstones, there must be a perceptible quantity of very questionable dirt.

From the conveyor above referred to, the wheat passes to bins, and thence to a grading machine, by which it is separated into three sizes, in order that the action of each of the first break rolls will be the more perfect by acting on grain of uniform size. With rolls set at the proper distance apart, so as to simply crack the wheat, chiefly along the crease, the result will be unsatisfactory,



Figs. 2 and 3—THE BLACKBURN MILL, ON THE ROLLER MILL SYSTEM.

CARTER'S HORIZONTAL FOUR-ROLLER BREAK MILL.

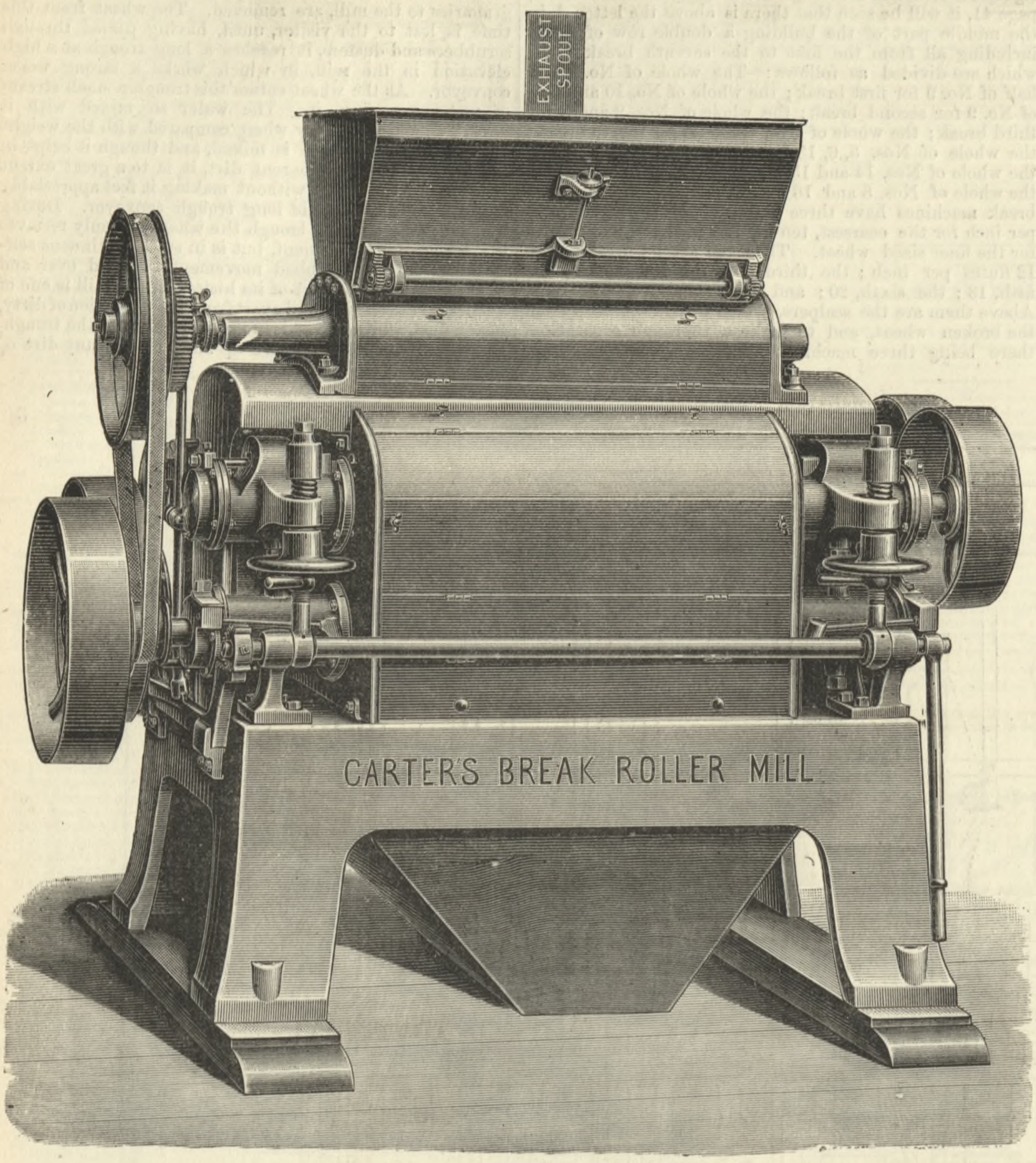


Fig. 4

unless the wheat is of uniform size, for the smaller grain will pass uncracked, or the large grain will be too much broken.

In the first break it is desirable that the wheat should only be sufficiently broken, and the break should be along the crease if possible, so that any dirt shall be released, and as little flour as possible made or released. The first break meal or chop which enters the reduction and re-

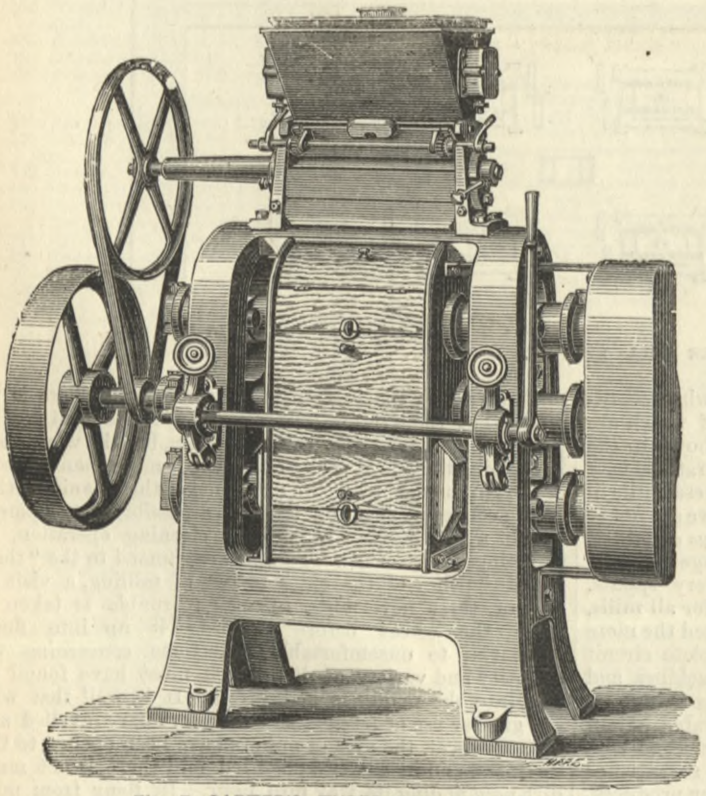
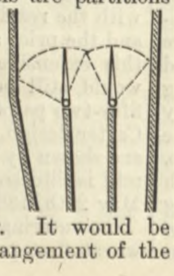


Fig. 7—CARTER'S THREE-HIGH ROLLER MILL.

dressing part of the mill separately has one-half per cent. of so-called black or first break flour taken out. The wheat, after it has passed through the first break rolls and scalpers, has a more uniform size, and it can be treated altogether by rollers with twelve flutes per inch, and so on up to the seventh break. The scalpers are clearly seen in the longtiudinal elevation above the break rolls. In the centre of this elevation will be seen the dust rooms or boxes, beneath which are two exhaust fans, which draw from an exhaust trunk below them, as shown. This is in communication with all except the first break rolls, and is also in connection with six aspirators, with louvre boards in front, placed between the six break elevators, where the broken and scalped wheat is purified by a blast of air, which aspirator also splits the feed on to the different machines. Most of the dust from the exhaust trunk is collected in the dust rooms above, whilst the heavier dust is carried along in the exhaust trunk by a worm, and collected at one end. The products from the different break rolls are carried to the corresponding elevators by two worm conveyors below, whilst these elevators deliver to the corresponding scalpers, and these to the following set of break rollers—*i.e.*, first roll by elevator to first break scalper; from there through aspirator to second break, and so on to the seventh break, the products of which go into the bran dusters.

The outsiftings of the second and third break scalpers are taken into the mill by themselves for further treatment; also the outsiftings of the fourth and fifth break scalpers, and the outsiftings of the sixth break scalper go by themselves. The first and second break is the opening of the wheat; the third, fourth, and fifth break is taking out the middlings, and the sixth and seventh the cleaning of the husk.

It should have been mentioned that as the wheat passes to the grader it passes by and amongst a number of horseshoe magnets grouped together. These separate all the small pieces of iron which by accident get into the wheat. Chiefly it is short pieces of wire, tacks, screws, and nuts, some of which have evidently come off elevator cup bolts of the thrashing machine or of the mill itself. The pieces of wire which are found in great quantities come with American wheat, and through the sheaf-binding machines which are largely in use in America. In the spouts from the box into which the grader delivers to the first break mills are partitions thus, the upper parts of which are pivotted, so that they may be placed in any of the positions indicated by the dotted lines, and the grain directed to either or all of the three deliveries. The quantity of any grade passing to either of the first breaks may thus be varied at will by the miller, according to the sample he is obtaining. It would be useless for us to describe here the arrangement of the



centrifugals, separators, purifiers, and aspirators through which the material passes before it is finished flour; and it is only necessary to say that large as is the quantity of machinery employed by Messrs. Greenwood, they are of opinion that even better results can be obtained by the adoption of new machinery, so that each machine of whatever kind has but a small range of work to perform. Each machine will thus be able to perform more work and at less cost for repairs. Of this there seems to be no more doubt than there is as to the division of labour or of work through any other class of special machines.

There are numerous effects obtained in these mills which are of much interest, not the least of which is the behaviour of the material in different stages as operated upon by the exhaust blast, whether for effecting a separation or grading of the middlings, or raising and carrying away fine bran or fluff.

All the elevator or cup belts are of leather, and all the driving is done by leather straps, except in the case of the transmission from a main shaft below to the shaft in the grinding room which drives the scalpers and break elevators, which is done by ropes. The couplings on the

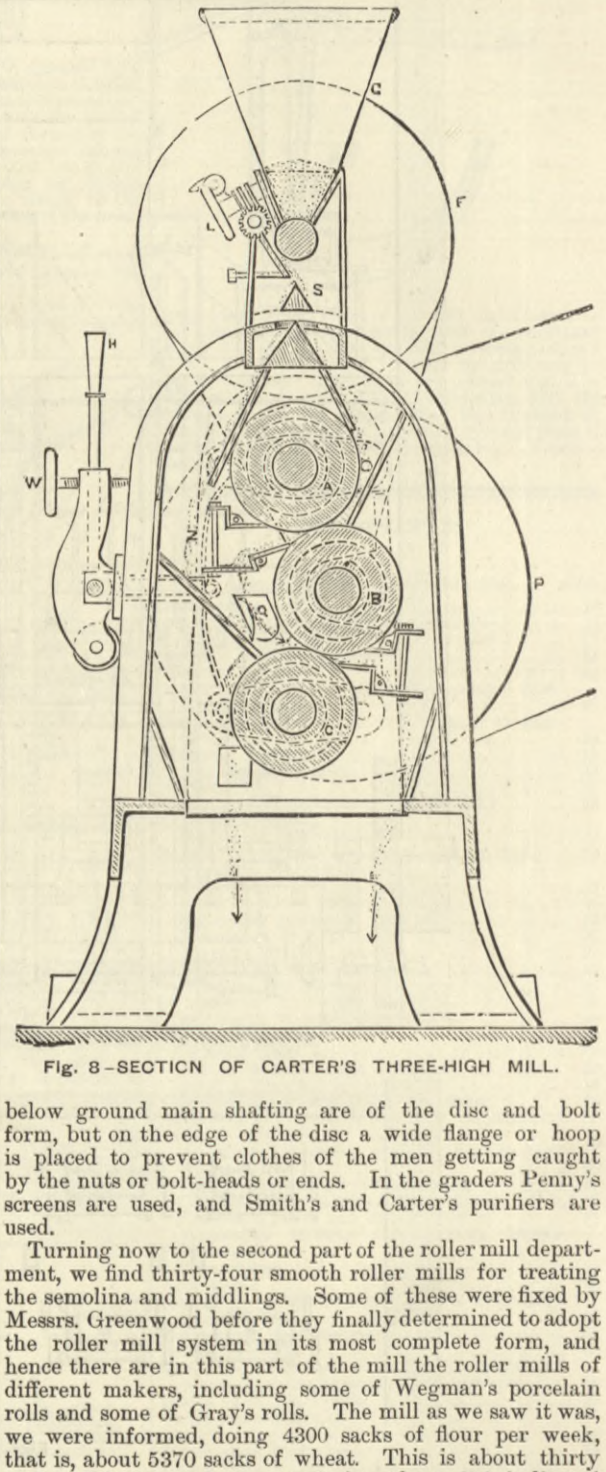


Fig. 8—SECTICN OF CARTER'S THREE-HIGH MILL.

below ground main shafting are of the disc and bolt form, but on the edge of the disc a wide flange or hoop is placed to prevent clothes of the men getting caught by the nuts or bolt-heads or ends. In the graders Penny's screens are used, and Smith's and Carter's purifiers are used.

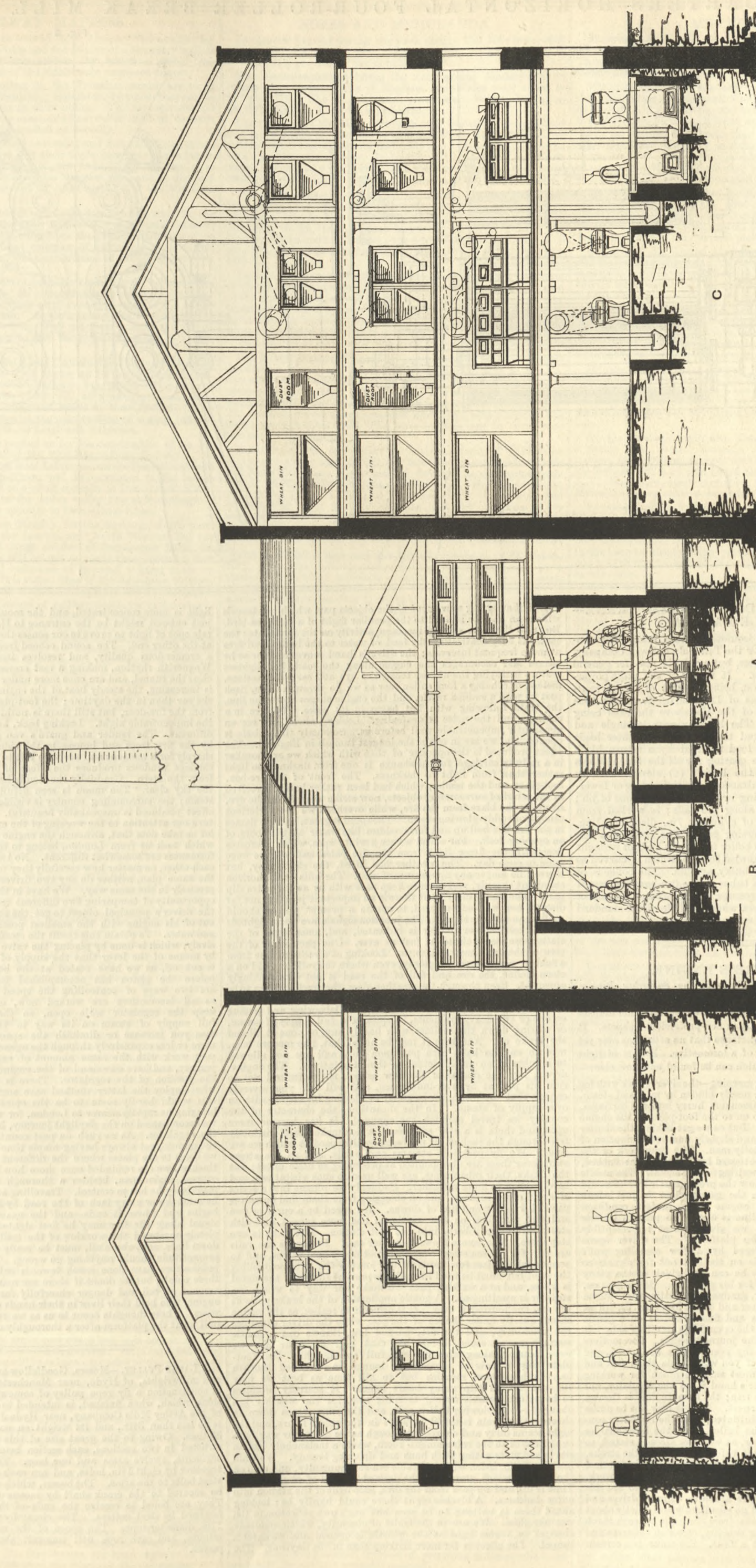
Turning now to the second part of the roller mill department, we find thirty-four smooth roller mills for treating the semolina and middlings. Some of these were fixed by Messrs. Greenwood before they finally determined to adopt the roller mill system in its most complete form, and hence there are in this part of the mill the roller mills of different makers, including some of Wegman's porcelain rolls and some of Gray's rolls. The mill as we saw it was, we were informed, doing 4300 sacks of flour per week, that is, about 5370 sacks of wheat. This is about thirty sacks of flour per hour, consuming about 358 indicated horse-power. This gives about 15 indicated horse-power per sack of stone flour, whilst the new roller plant only takes 11·9 per sack, but these results are not so satisfactory as other mills on Carter's system owing to the heavy gearing as explained before.

INTERNATIONAL INVENTIONS EXHIBITION.—The Council of the Society of Arts announce that they will award the following Gold Medals in connection with the International Inventions Exhibition:—Under the Joint Stock Trust, one Gold Medal for the best application of Photography to a Permanent Printing Process; Group XXVI., Class 140; Group XXIX., Class 159. Under the Howard Trust, five Gold Medals for the best exhibits—coming within the terms of the Trust—in the following classes:—One for the best exhibit in Group IV., "Prime Movers," Class 26—Steam Engines and Boilers; one for the best exhibit in Group IV., Class 27—Gas and Air Engines; one for the best exhibit in Group IV., Class 28—Means of Utilising Natural Forces; one for the best exhibit in Group XI., "Hydraulic Machines, &c.," Classes 59 to 62; one for the best exhibit in Group XIII., "Electricity," Class 72—Distribution and Utilisation of Power. Under the Fothergill Trust, one Gold Medal for the most novel and best exhibit in Group XXVIII., "Philosophical Instruments and Apparatus," Classes 148 to 158. Under the Alfred Davis Trust, three Gold Medals to be awarded in Division II. of the Exhibition—Music—Groups XXXII. to XXXIV., Classes 166 to 180. The Council propose to ask the Juries in each Class to recommend for their consideration either two or three exhibits which they might consider deserving a prize. It will not be necessary for any special application to be made in respect of these prizes. The medals are each of the value of £20.

MESSRS. GREENWOOD AND SON'S FLOUR MILL, BLACKBURN.

J. HARRISON CARTER, LONDON, MILLING ENGINEER.

(For description see page 39.)



CARTER'S HORIZONTAL FOUR-ROLLER BREAK MILL.

Fig. 5

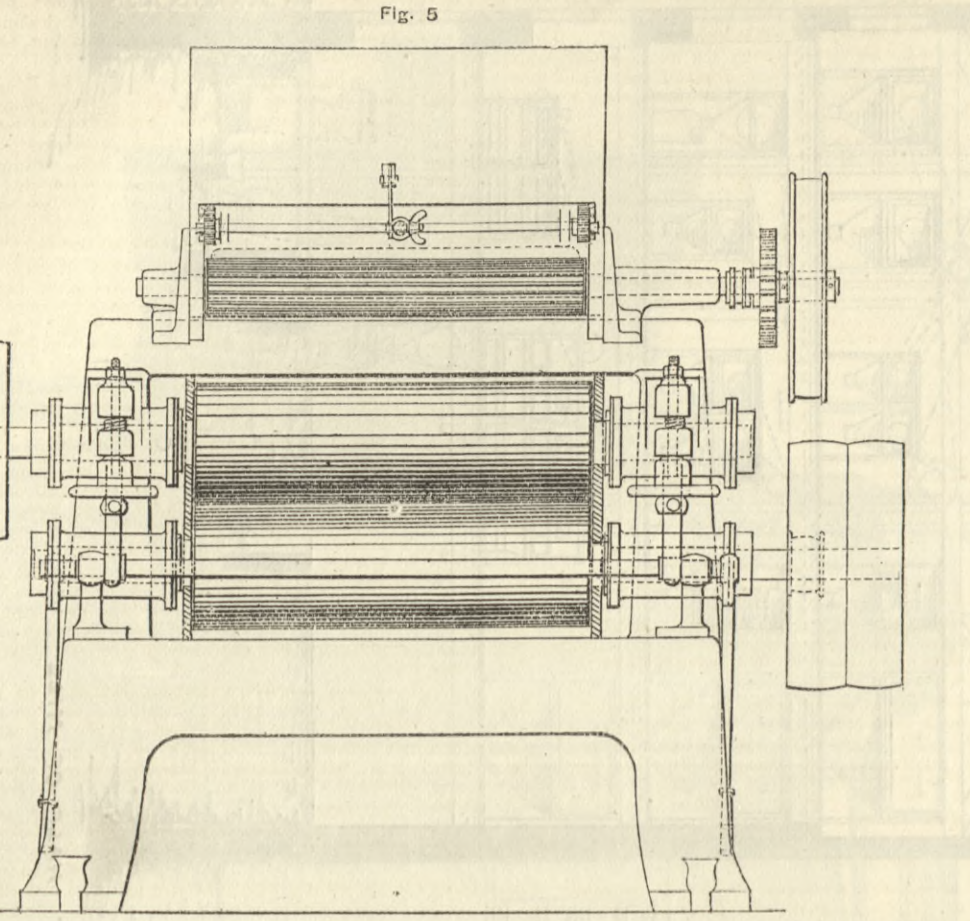
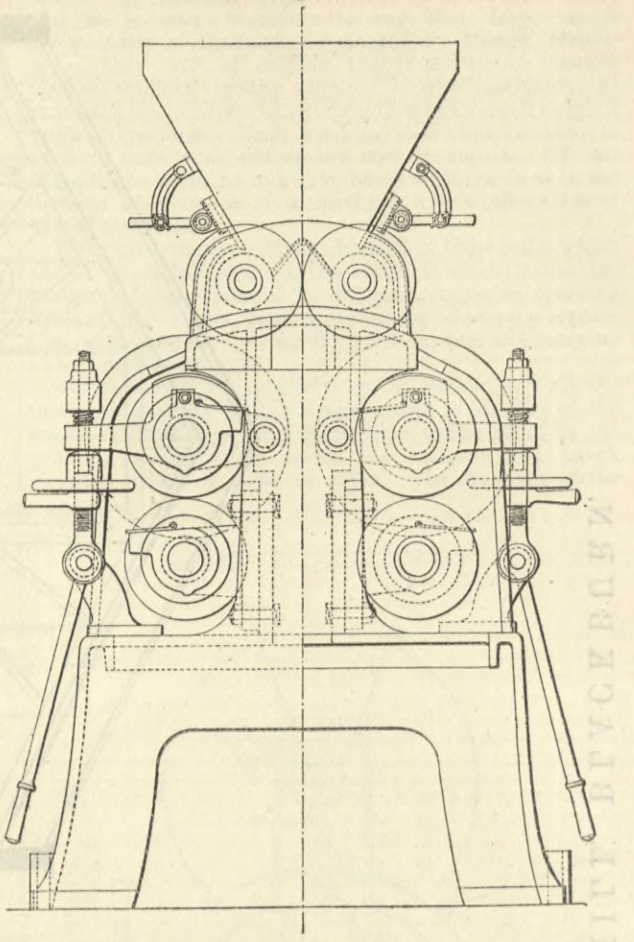


Fig. 6



LOCOMOTIVE BREAKDOWN STEAM CRANE—TAFF VALE RAILWAY.

OUR illustration shows a locomotive steam crane just constructed by Messrs. Chaplin for the Taff Vale Railway Company, for railway breakdown purposes, but available also for general work in the locomotive yards. It is one of the most powerful cranes of the class yet made, being capable of lifting loads up to twenty tons at a radius of 12ft., or up to twelve tons at radius of 18ft., the height of the jib above the rails being 20ft. at the latter radius. The hoisting gear is single and double purchase, being arranged thus for lifting lighter loads at increased speed. The full load is lifted by a return block and two falls of chain. The gearing for all the four motions of (1) hoisting or lowering the loads; (2) slewing entirely round in either direction, simultaneously with hoisting or lowering when desired; (3) adjusting or altering the radius of jib; and (4) propelling the crane along the rails; is worked from the engine, which has a pair of cylinders 7in. diameter, 12in. stroke, with link motion reversing gear. The framing which carries the engine, gearing, and boiler is entirely built of wrought iron plates and angles, as is likewise the jib, which is curved to give more head-room in lifting bulky articles. The boiler is of the vertical class, having cross tubes in the fire-box, and tested to double the working steam pressure. The carriage is built of wrought iron, and fitted with six wheels and the usual standard permanent way draw gear, springs, and buffers.

ON AN EXPRESS ENGINE.

WE reprint the following article from the *Saturday Review*. Although not bearing any internal evidence of having been written by an engineer, it is a pleasant contrast to certain other articles which have appeared occasionally in non-professional papers. It is a somewhat remarkable circumstance that no artist has ever yet done justice to the foot-plate of a locomotive. Effects of light and shade may be seen there which can be found nowhere else:—

"It is a somewhat unpromising morning—the river is dark with fog and the huge arch of the station nearly hidden by mist and steam. A cold, damp wind makes the passengers hurry into the carriages, and strikes us sharply as we step on to the foot-plate of the engine which has just joined the train. But as we get behind the shelter of the screen we feel a generous and slightly unctuous sensation of warmth very comforting to a chilly man. The brasswork of the engine shines brilliantly, the footboard has been newly scrubbed, and the driver and stoker stand waiting for the signal. The needle shows that the steam is just below the pressure at which it would begin to blow off; the water in the gauge glass is just where it ought to be; in fact, the engine is in perfect condition and ready for a start. The line is clear, the guard's whistle is answered by our own, and we glide almost imperceptibly past the last few yards of the platform. The driver opens the regulator till he is answered by a few sounding puffs from the funnel, and then stands on the look out for signals so numerous that one wonders how he can tell which of the many waving arms is raised or lowered for his guidance. So he goes on, with hand on regulator and lever, gradually admitting more steam as signal after signal comes nearer and then flies past us, till at last we are clear of the suburbs and find ourselves on a gentle incline and a straight road, with the open fields on either side. It is now that the real business of the journey begins. Locomotives are as sensitive and have as many peculiarities as horses, and have to be as carefully studied if you would ride them fast and far. The lever is put into the most suitable notch for working the steam expansively; the driver's hand is on the regulator, not to be removed for the rest of the trip; the furnace door is thrown wide open, and firing begins in earnest. Here it may not be amiss to state, for the benefit of the uninitiated, that the regulator controls the supply of steam from the boiler, while the lever enables the driver to reverse the engine, or, as we have already stated, to expand the steam by cutting it off before the end of the stroke. The engine answers to the appeal like a living thing, and seems, with its steady beat and sonorous blast, to settle down to its work. It is pleasant from our seat in the corner of the screen to see this preparation for the work ahead—the absolute calm of driver and stoker, who exchange no word, but go steadfastly and quietly about their business; to feel the vibrations from the rails beneath throb through one with slowly increasing rapidity, or watch the trees and houses go past as gulls flap past a boat. For there is a certain apparent swagging movement of the objects past which one travels which can only be likened to the peculiar flight of a large sea-bird. But now there are signs of increased activity on the foot-plate; the stoker is busy controlling the feed of water to the boiler, and fires at more frequent intervals; the driver's hand moves oftener as he coaxes and encourages the engine along the road, his slightest gesture betraying the utmost tension of eye and ear; the stations, instead of echoing a long sullen roar as we go through them, flash past us with a sudden rattle, and the engine surges down the line, the train following with hot haste in its wake. We are in a cutting, and the noise is deafening. Looking ahead, we see an apparently impenetrable wall before us. Suddenly the whistle is opened, and we are in one of the longest tunnels in England. The effect produced is the opposite of that with which we are familiar in a railway carriage, for the change is one from darkness to light rather than from light to darkness. The front of the fire-box, foot-plate, and the tender, which had been rather hazily perceived in the whirl of surrounding objects, now strike sharply on the eye, lit up by the blaze from the fire, while overhead we see a glorious canopy of ruddy-glowing steam. The speed is great, and the flames in the fire-box boil up and form eddies like water at the doors of an opening lock. Far ahead we see a white spec, which increases in size till the fierce light from the fire pales, and we are once more in open day. The weather has lifted, the sky is grey, but there is no longer any appearance of mist. The hills on the horizon stand out sharply, and seem to keep pace with us as the miles slip past. The line is clear; but there is an important junction not far distant, and we slacken speed, to ensure a prompt pull-up should we find an adverse signal. The junction signals are soon sighted; neither caution nor danger is indicated, and, once clear of the station, we steam ahead as fast as ever. One peculiarity of the view of the line ahead strikes us. Looking at a railroad line from a field or neighbouring highway, even where the rails are laid on a steep incline, the rise and fall of the road is not very strikingly apparent. Seen through the weather-glass, the track appears to be laid up hill and down dale, like a path on the downs above high cliffs. Over it all we advance, the engine labouring and puffing on one or two heavy gradients, in spite of a full supply of steam, or tearing down the inclines with hardly any, or none at all and the brake on. And here it may be noted that, like modern men, modern engines have been put upon diet, and are not allowed to indulge in so much victual as their forefathers. The engine-driver, like the doctor of the new school, is determined not to ruin his patient by over-indulgence, and will tell you severely enough that 'he will never be guilty of choking his engine with an over-supply of steam.' In the meantime, the character of the country we travel through has changed. It has become more open, and there is a stiff sea breeze, which makes itself distinctly felt through the rush of air produced by the speed at which we are going. We fly past idle streams and ponds, and as the steam swirls over them are disappointed at producing so little effect; but the ducks, their inhabitants, are well used to such visitations, and hardly deign to move a feather. Suddenly we plunge into a series of small chalk cuttings, and on emerging from them find ourselves parallel with a grand line of downs. We speed by a curve or two and find ourselves on the sea-shore; one more tunnel, and with steam off we go soberly into the last station. But there is one step more. The breeze blows about our ears. Before us the rails are wet, for the sea swept over them not many hours since, and to accomplish the last few yards of our journey the lever controlling the sand-box must be used liberally, to prevent slipping; the signal is given, and at a walking pace we make our way to where the steamer is awaiting us. A gentle application of the brake pulls us up, and the journey is over. It is difficult to realise, as the engine stands quietly under the lee of the pier while the driver examines the machinery, and the fire, burned low, throws out a gentle warmth as we stand before it, that half an hour ago we were tearing along the line at full speed, while the foot-plate that is now so pleasant to lounge on throbbed beneath us. Nothing now remains but to kill time as best we may till the return trip many hours hence. It scarcely promises to be as comfortable as our morning ride, for the weather has changed—it is blowing half a gale, and the rain comes down in sheets. Our train is timed to start in the small hours, and the night seems dirty and depressing enough as we make our way for a cup of coffee to the refreshment- room, where a melancholy Italian sits in sad state eating Bath buns and drinking brandy. We walk past the train, laden with miserable sea-sick humanity, and step on the engine, which stands in the dark at the end of the platform, Time is up, and we pass from the dim, half-light of the station into outer darkness. A blacker night there could hardly be; looking ahead there is nothing to be seen but one's own reflection in the weather-glass. We are in the midst of obscurity, which suddenly changes to a rich light as the whistle is opened and we enter a tunnel. The effect is far more striking than in the daytime. The light is more concentrated, and the mouth of the tunnel we have just entered might be the entrance to Hades—for there is no tell-tale spot of light to prove to our senses the existence of any opening at the other end. The sound echoed from the walls and roof has a tremendous quality, and resolves itself into a grand sort of Wagnerian rhythm, making a vast crescendo, till with a rush we clear the tunnel, and are once more under the open sky. The pace is increasing, the steady beat of the engine tells more distinctly on the ear than in the daytime; the foot-plate is lit up by the glare from the fire-door, but still there is nothing to be seen ahead but the impenetrable night. Looking back, however, the scene is very different. The tender and guard's van glow in the light thrown by the fire, trees and houses by the side of the track stand out sharply for a moment and are then lost to sight, the light from the carriage windows produces the effect of the wake of a ship seen from the stern. Gradually the clouds have rolled away, leaving the sky clear. The moon is seen fitfully through the whirling steam; the surrounding country is visible for miles round. The effect produced is unspeakably beautiful. In the meantime let us turn our attention to the working of the engine. In the first place, let us take note that, although the engine we are now on, and that which took us from London, belong to the same type, their performances are somewhat different. No two engines ever resemble each other, no matter how carefully they may have been built from the same plan, neither do any two drivers manage their engines precisely in the same way. We have in this instance an excellent opportunity of comparing two different methods of driving. It is the driver's principal object to get the required amount of work out of his engine with the smallest possible expenditure of coal and water. To obtain this result the steam must be worked expansively, which is done by placing the valve gear in such a position by means of the lever that the supply of steam to the cylinders is cut off, as we have stated at the beginning of this article, before the piston has accomplished its full stroke. There are two ways of controlling the speed of an engine worked, as all locomotives are worked now, expansively. You may keep the regulator wide open, so that there is always a full supply of steam on its way to the cylinders, in which case you increase or diminish the speed by using the steam more or less expansively through the agency of the lever. Or you may work with the same amount of expansion throughout the journey, and have command of the engine by constantly changing the position of the regulator. There is no doubt that the men who employ the latter method save something by it—although this would hardly seem to be the opinion of the driver who is bringing us rapidly nearer to London, for unlike the driver whom we accompanied on the daylight journey, his hand is not often on the regulator. As we rush on past countless signals, punctual to the minute, yet always having ample time to slacken speed before we come to the places where the different coloured lights cluster thickest, we are reminded once more how much is required of an express engine-man, besides a thorough acquaintance with the machinery he has to control. Travelling at night at a great speed, he must know every inch of the road by heart—where an incline begins and where it ends—and the exact spot at which every signal along the line may be first sighted. He must have completely mastered the working of the traffic on both the up and down lines, and, above all, must be ready to act with the utmost promptitude should anything go wrong. Mr. Michael Reynolds' publications have done much towards enlightening the public on these points, but we doubt if there are many who really know the amount of toil and danger cheerfully faced by the men on the engine, who hold their lives in their hands day after day for many years. These thoughts occur to us as we recross the Thames and pull up at the platform after a thoroughly enjoyable run."

A LARGE PULLEY.—Messrs. Goodfellow and Matthews, engineers and millwrights, of Hyde, near Manchester, have now in course of construction a fly rope pulley of somewhat remarkable dimensions, which, when finished, is intended to be used in the factory of the Astley Mills Company, near Hyde Junction. Its diameter is no less than 34ft., and its weight on completion will be about 83 tons. Owing to the great size of this pulley it is being constructed in two sections, each section being made up of twelve segments, twelve arms and one boss. The segments are joined together by eight 1½in. bolts, and are each attached by four 2½in. steel bolts to the arms. The bosses, which each weigh 8 tons, will be secured to the crank shaft by means of steel keys 7in. wide. They are bored to receive the ends of the arms, which will be fastened by steel cotters. The circumference has 32 grooves for 1¾in. diameter rope. The speed of the ropes will be 5350ft. per minute, and each rope will transmit about forty actual horse power.

RAILWAY MATTERS.

Two men and six horses were killed at Limpley Stoke on Sunday morning by a partial landslip and the failure of a boundary wall at the Great Western Railway station, by which a stable was demolished. Two horses in the stable were recovered unhurt.

THE shunting locomotives in the Prussian service are to be provided with a fire-extinguishing apparatus, by which they can be converted into fire engines at short notice. This arrangement has already been tried in a few cases, and has proved itself of so much service that it is now to be applied universally.

THE Americans make their own rails, and make us pay on things we send them for railways, but their trade does not seem to fatten the railways. The directors of the Lake Shore Railway have decided not to pay any dividend for the past year, and no dividend was declared at the meeting of the directors of the Michigan Central Railway.

THE Official Commission charged with the arrangements for the celebration this year of the 50th anniversary of the establishment of railways in Belgium has adopted as the principal features of its programme an international congress of engineers, an historical and allegorical procession, and an exhibition of various objects connected with railways.

ON Saturday night the Great Northern down express from London to Manchester had an extraordinary escape at Ordsall-lane level crossing. The attendant at this crossing received and passed signal for an up goods train. At the moment a cart containing five men came up to cross the line. The gate was opened, the horse's foot on the rails, just time to step back, gate smashed to atoms, everybody escaped.

THE Manchester, Sheffield, and Lincolnshire Railway Company announce that they have a bill deposited for authorising the construction of a railway, twelve miles in length, from Shireoaks to Staveley and Chesterfield, which will, at a moderate cost, afford access to the large and important works in these districts. This Bill also proposes to authorise the construction of a short branch, about three miles in length, to Leigh and Atherton.

THE surveys are being pushed on for the construction of an important strategic line, called the Sind-Sagur-Doab Railway. The existing narrow-gauge line from Lalamusa, on the Punjab Northern Railway, to Pind-Dadun-Khan, will be converted to the broad-gauge one, and continued to a point opposite to Dera-Ismail-Khan, and thence southward to the Indus valley line at Mozuffergurh, with a branch to a point opposite to Dera-Ghazi-Khan.

ORDERS were issued, on Monday, for the discharge of 100 more men from the works of the London and North-Western Railway Company at Crewe. A large number of furnacemen have also received orders that they will be put on short time—namely, four days a week. A general reduction of the staff is being made up and down the system. It is stated that if the depression in trade continues several thousand workmen altogether will be discharged.

THE *Railroad Gazette* record of railway accidents in America in November contains notes of 45 collisions, 47 derailments, and 4 other accidents—96 accidents in all, in which 47 persons were killed and 130 injured. Sixteen collisions and ten derailments caused death; six collisions and six derailments lesser injuries. In all twenty-six accidents caused death, and twelve injuries but not death, leaving fifty-eight accidents, or 60 per cent. of the whole number, in which there was no injury to persons recorded.

THE facts relating to the mishap at the Forth Bridge works, anent which a rather serious picture was drawn by some contemporaries, seem to be these:—On the 1st instant one of the group of four 70ft. diameter caissons, constituting the south main pier, slid forward on the mud about 20ft., and tilted over to an angle of 25 deg., which caused the water to flow over the top edge and sink the caisson. The caisson had been floated into position on the 1st of December and weighted with 3000 tons of concrete, but sinking operations had not commenced, and the caisson floated at about half tide. It will be necessary to pump out the caisson at low water and float it again into position, operations of no difficulty whatever.

THE directors of the Manchester, Sheffield, and Lincolnshire Railway Company, in their report for the half-year ended the 31st December last, state that the net revenue account shows a balance, including £2855 10s. 7d. brought from the previous half-year, of £423,079 11s. 10d. The preference charges amount to £310,248 14s. 0d., leaving a balance of £112,830 17s. 10d., out of which the directors recommend that a dividend be paid at the rate of £4 per cent. per annum on the ordinary stock of the company, carrying forward the sum of £2979 16s. 8d. to the following half-year. The directors regret this diminution in the dividend, caused by depression in the trade of the country; but when it is remembered that the decrease in the value of the imports and exports of the past year, as shown by the Board of Trade returns, amounts to £42,701,000, the figures being £665,404,000, for 1883, against £622,703,000 for 1884, it is no matter of surprise that the railway traffic of the country exhibits a serious falling off. The low rate of freights by the company's steamers to and from Hamburg and Rotterdam, owing to severe competition, have unfavourably affected the revenue during the greater part of the half-year.

THE new line which is to connect New-street Station, Birmingham, with the West Suburban Railway and the Midland system is making rapid progress, and will be completed in August or September. The Midland Company intends to make this route, *viâ* Granville-street and the West Suburban Railway, their main line to Bristol and the west, as it is very much more direct than *viâ* Camp Hill. A tunnel 80 yards long has been constructed under Suffolk-street, terminating in Wharf-street near to Curzon Hall. The line then passes through an open cutting 55ft. deep, and is supported on each side by substantial retaining walls for a distance of a further 80 yards, after which a covered way nearly 100 yards long is reached. This extends to Worcester Wharf, after which another open cutting is entered. This is succeeded by another tunnel 260 yards long. Considerable engineering difficulties were encountered and overcome in the construction of this last tunnel, the canal having to be dammed up at each end during this part of the work. A second tunnel under Worcester Wharf is being constructed for goods traffic. At New Bridge-street a handsome passenger station is to be built, to replace the temporary structure in Granville-street. The contract for making the new line was given to Mr. Firbank, Newport, Mon. Mr. G. Kirby has had the charge of the tunnelling operations. During the greater part of the time about 1200 men have been engaged on the new line.

THE extensions which are being carried out by the London and North-Western and the Midland Railway Companies, so as to increase the traffic facilities at New-street Station, Birmingham, are progressing very satisfactorily. The area of the station has been more than doubled, and a new route has been opened up by the Midland Company with its western system. It is expected that about two millions sterling will have been expended by the companies when the work is completed. After nearly two years of active and continuous operations, the enlargement of the station is now nearly completed. The waiting and refreshment rooms, lavatories, and buildings for the reception of goods have been erected. The north tunnel has been opened up a considerable distance to increase the area for sidings, and the south tunnel has been opened up on the other side to Worcester-street as far as the Bull Ring. The lines of rails from the new portion of the station converge in the south tunnel, passing underneath the upper end of Great Queen-street, a girder bridge having been constructed to carry the street. The permanent way has been laid, and it is thought probable that trains will begin to run some time in February or March. The iron girders and general work needed for the parcels and goods offices has been executed by Messrs. Horton and Co., of Darlaston, and the engineering work and structural plans have been designed by Mr. Cotton, the North-Western Company's local engineer, under the directions of Mr. Stephenson, the head engineer of the company, who has superintended the whole of the extensions.

NOTES AND MEMORANDA.

IN Greater London during the week ending the 10th inst., 3656 births and 2408 deaths were registered, equal to annual rates of 36·7 and 24·2 per 1000 of the population.

THE deaths registered during the week ending January 10th in twenty-eight great towns of England and Wales were equal to 24·9 per 1000. The six healthiest places were Bolton, Brighton, Sheffield, Bradford, Derby, and Leeds.

CAST iron, says Mr. M. L. Forquignon, if heated for several days to a temperature of from 900 to 1000 deg. Cent., neither melts nor softens, but is converted into malleable iron. Its surface is covered with a grayish efflorescence. Its fracture is sometimes of a uniform black, like that of a lead pencil, and sometimes riddled with large black points which are regularly distributed in the metallic paste.

IN London during the week ending the 10th inst. 2816 births and 1956 deaths were registered. The annual death-rate per 1000 from all causes, which had been 20·7, 18·6, and 24·9 in the three preceding weeks, further rose last week to 25·0. During the thirteen weeks ending 27th ult., the death-rate averaged only 19·8 per 1000, against 21·6 in the corresponding periods of the five years 1879-83.

SIGNOR A. RICCO sends *Nature* a lengthy memoir on a new form of electro-magnet invented by him. It consists of a sheet of iron rolled into a spiral, round an iron core, the convolutions being separated by oiled paper. The current traverses the coiled sheet, which thereby becomes powerfully magnetised. A spiral of forty turns of insulated copper wire is added outside. The lifting power of this magnet appears to be very great in proportion to its weight.

DR. E. VON FLEISCHL recently communicated to the Viennese Academy a paper on the double-refraction of light in liquids. Concentrated solutions of tartaric acid and of various sugars were employed; also certain active oils, in a compound hollow prism resembling a Fresnel's quartz combination in its general disposition. The research proves the existence of doubly-refracting liquids, but they possess no optic axis. The wave-surfaces are in every case two concentric spheres.

A PAPER recently read before the Paris Academy of Sciences by M. Onimus states that during the late cholera outbreak at Paris and Marseilles there was a marked decrease in the atmospheric ozone. In Marseilles the mean for July was 0·86, while in July, 1883, it was 2·17. In Paris in November, 1884, it was 0·44, and in 1883, 1·82. The author concludes that the condition of the atmosphere was favourable to the spread of the disease. Better drainage, less crowding, and better water supply, would be greater enemies to cholera than any such change in the quantity of ozone.

FOR an indelible stamping ink, M. E. Johanson, of St. Petersburg, gives the following for marking textile materials by a stamp:—22 parts of carbonate of soda are dissolved in 85 parts of glycerine, and triturated with 20 parts of gum arabic. In a small flask are dissolved 11 parts of nitrate of silver in 20 parts of official water of ammonia. The two solutions are then mixed and heated to boiling. After the liquid has acquired a dark colour, 10 parts Venetian turpentine are stirred into it. The quantity of glycerine may be varied to suit the size of the letters. After stamping, expose to the sun or apply a hot iron.

THE number of patents applied for during the year 1884, under the Act which came into force on the 1st January of that year, was 17,110. The largest number reached in any previous year was 6241 in 1882. In 1883 the number slightly fell off, doubtless in consequence of many patentees preferring to wait for the reduction in fees effected by the new Act, though the number of 5993 was reached, a number in excess of the year 1881 (5751), and of any previous year. It may be added that no approach has yet been made to the average number of applications in America. The number of patents applied for in the States in 1883 was 33,073.

AN official report has been published on the fossil and mineral products, &c., of the Ichang consular district—China—wherein it is pointed out that three kinds of fossils produced in the district are staples of trade, viz.: (1) Pagoda stones—*ethoceras*; (2) Kosmos stones—*ammonites*; and (3) stone swallows. The *othoceras* found in slate at Nanchich-ah is cut, and is either framed as a picture or made into ornamental furniture. The same is true of the *ammonites*, which are called Kosmos stones from their resemblance when polished to the Chinese symbol for Kosmos. No duty is yet charged on the export of these fossils; they do not, therefore, appear in the trade returns. The third kind of fossil, called by Chinese "stone swallows," is ground down and used as medicine. Coal is plentiful in this district; only when it is exactly suited to the native's requirements, or where the mine is favourably situated, is it worked to any extent. In many places the shafts are left open and coal extracted as people in the neighbourhood require it. Iron also exists almost all over the Ichang district; iron cauldrons and rude agricultural implements are, to a certain extent, exported thence in native vessels.

M. DUPUY DE LOME recently called the attention of the French Academy of Sciences to a new piece of ordnance of superior power. The Société des Forges et Chantiers de la Méditerranée has recently constructed a small, powerful gun for the Spanish Government, and of the following dimensions: It is a naval gun of 16 cm. calibre, having a breech made according to the designs of General Honoria, of the Royal Spanish Naval Artillery, and on the principles which the Société des Forges at Chantiers have laid down to prevent unbreeching. The calibre of the piece is 161 mm.; the diameter of the powder chamber, 200 mm.; the length is 5890 mm.; the weight, 6200 kg.; and the weight of the projectile is 60 kg.; the charge of powder is 32·5 kg.; the velocity of the projectile at the muzzle, 632 m. per second; the maximum pressure with the powder used, 2250 atmospheres; and the maximum thrust along the axis measured at the widest part, 706,000 kg. The kinetic energy of the projectile at the muzzle is 1222 metre-tons, and the ratio of the kinetic energy of the projectile to the weight of the cannon is 197, whereas with the 16-cm. piece of the French Marine this ratio is only 168, that of the 6in. British No. 3 is 168, while the Krupp 15-cm. gun gives 153 for the same ratio. The recoil lasts for 0·21 of a second, as measured by Sebert's velocimeter, and is limited to 70 cm.

THE "Journal of the Straits Settlements Branch of the Royal Asiatic Society" contains a communication from Sir Hugh Low, President of Perak, of a paper written by Mr. S. Wray, jun., on gutta percha. It contains information of great importance, considering the growing application of gutta-percha. It appears that the *Getah taban merah* (*taban*, the name of a tree; *merah*, red), *dichopsis, isonandra, gutta*, yields the best kind of gutta, and used to be plentiful in the jungles of the plains of Perak, stretching to a short distance up the hill sides. It seems to like considerable moisture, and will grow with its roots in a running stream. It is a tree of large size, attaining a diameter of from four to five feet, and a height of from 100ft. to 200ft. It has large thin convex buttresses reaching six to eight feet up the stem, which is clean, straight, with a rich brown coloured bark one-third to half an inch thick, peeling off in irregular pieces. The gutta from this tree is at first milk white, changing to red on exposure. It is collected as follows:—A staging is built round the tree so as to allow of cutting down above the buttresses. A *beliong*, or small axe, is used for this purpose. V-shaped rings, one inch broad and fifteen to eighteen inches apart, are then cut into the bark along the whole length of the trunk by means of a *parang* or heavy chopping knife. These cuts are soon filled with a white cream-like sap, which in half an hour separates, and may be rolled into balls and boiled. A tree 2ft. in diameter, at 6ft. from the ground, and 100ft. high, yielded 2 lb. 5 oz. of fairly clean gutta, valued by a Malay dealer at 1·20 dols. per catty, or 2s. 6d. per pound, or 7s. 6d. as the produce of the whole tree. The second portion of Mr. Wray's paper contains a proposed method of preparing gutta-percha so as to obviate the present wasteful method.

MISCELLANEA.

MENTION was made in this column of our last impression of the smoke rockets made by Mr. Paine for finding leaks in sewers, &c. These rockets are the invention of Mr. Cosmo Innes, not Mr. Cosmo Jones, as printed.

WE understand that the contract for the Bombay Dock Extension, amounting to about half a million pounds, has been secured by Messrs. Kirby, Fleming, and Wilson, of Bombay, whose London firm is Messrs. Fleming, Wilson, and Co.

WE are requested to state that Dr. William Pole, F.R.S., has been appointed honorary secretary of the Institution of Civil Engineers in the room of the late Mr. Charles Manby. The office of secretary is filled, as formerly, by Mr. James Forrest. Mr. H. L. Antrobus has been re-appointed treasurer.

WE understand that the Italian Church, Hatton-garden, has just been lighted with the Albo-Carbon Light by the Sanitary Engineering and Ventilation Company, of Westminster, who also recently applied the same system of lighting to the New Oratory, South Kensington, and several picture galleries, &c.

ON Tuesday Mr. Daniel Adamson, the chairman of the company, and Mr. James E. Platt and Mr. Henry Boddington paid the deposit money to the Accountant-General for the promotion of the Manchester Ship Canal Bill in the ensuing session. This year the deposit amounts to within a few pounds of £300,000.

THERE has been a series of landslips from a hill which stands behind the Greek Orthodox Cathedral and College at Czernowitz, in Bukovina. These buildings, which were erected in 1864 at a cost of 10,000,000fl., are thought to be in considerable danger. An adjacent farm building has already been buried by the landslip.

MESSRS. TANGYE have learned the great value of well got up catalogues, and added to the fine specimens of catalogue art which have left their premises, they have now sent out a well executed complete telegraphic code, by which any article in their 1884 pocket catalogue can be ordered by cable, by the use of one word only.

AT the Bowling Ironworks, Bradford, on Tuesday morning, as a young man, named Metcalfe, passed near a circular saw in motion, his right foot slipped, and the saw came into contact with his foot and cut it off just above the instep. Another man named J. T. Readshaw, aged fifty-nine, was so affected by the sight of Metcalfe's injury that he died almost immediately.

PROFESSOR ELGAR is about to deliver, in the University of Glasgow, a special course of evening lectures, twelve in number, upon the "Buoyancy and Stability of Ships." These lectures have been instituted for the convenience of persons who are employed in the various shipbuilding yards and elsewhere during the day, and are unable to attend the regular university classes in naval architecture.

THE Commissioners of Sewers have, the *City Press* says, accepted the contract of Messrs. Hammond and Co. for lighting the following streets by electricity, viz.:—Old Broad-street, front of Mansion House, Royal Exchange-buildings, Bartholomew-lane, Lothbury, Princes-street, Lombard-street, Birchin-lane, Bishopsgate-street Within, Throgmorton-street, Threadneedle-street, and Gracechurch-street.

MESSRS. ARCHD. SMITH AND STEVENS, of Janus Works, Queen's-road, Battersea, have been instructed by the Aërated Bread Company to erect at their new premises—Eastcheap House, Eastcheap—one of Stevens and Major's patent hydraulic balance passenger lifts, with their compensating apparatus for reducing the amount of water used. The architect of the building is Mr. George Edwards, of Brompton-road.

THE report of Dr. Frankland to the Registrar-General of the results of the chemical analyses of the waters supplied to the inner, and portions of the outer, circle of the metropolis during the month of December, show how remarkably satisfactory is the water supply by the whole of the London companies taken from the Thames, while the New River Company's supply fully maintained the quality of the previous month's samples, and ranked, as regards the proportion of organic matter, with the best of the deep-well waters. Both waters were clear and bright on delivery.

THE Jablochkoff and General Electricity Company, Limited, has been registered with a nominal capital of £20,000, divided into 200 shares of £100 each, for the purpose of purchasing the whole of the Jablochkoff patents, the stock and goodwill as a going concern of the late Jablochkoff Electric Light and Power Company, Limited. Sufficient capital has been privately subscribed, and the purchase contract has been confirmed by the Court of Chancery. Mr. Francis R. Reeves has been appointed secretary and manager of the new company, whose registered offices and works are at No. 36, Albert Embankment, Lambeth, London, S.E.

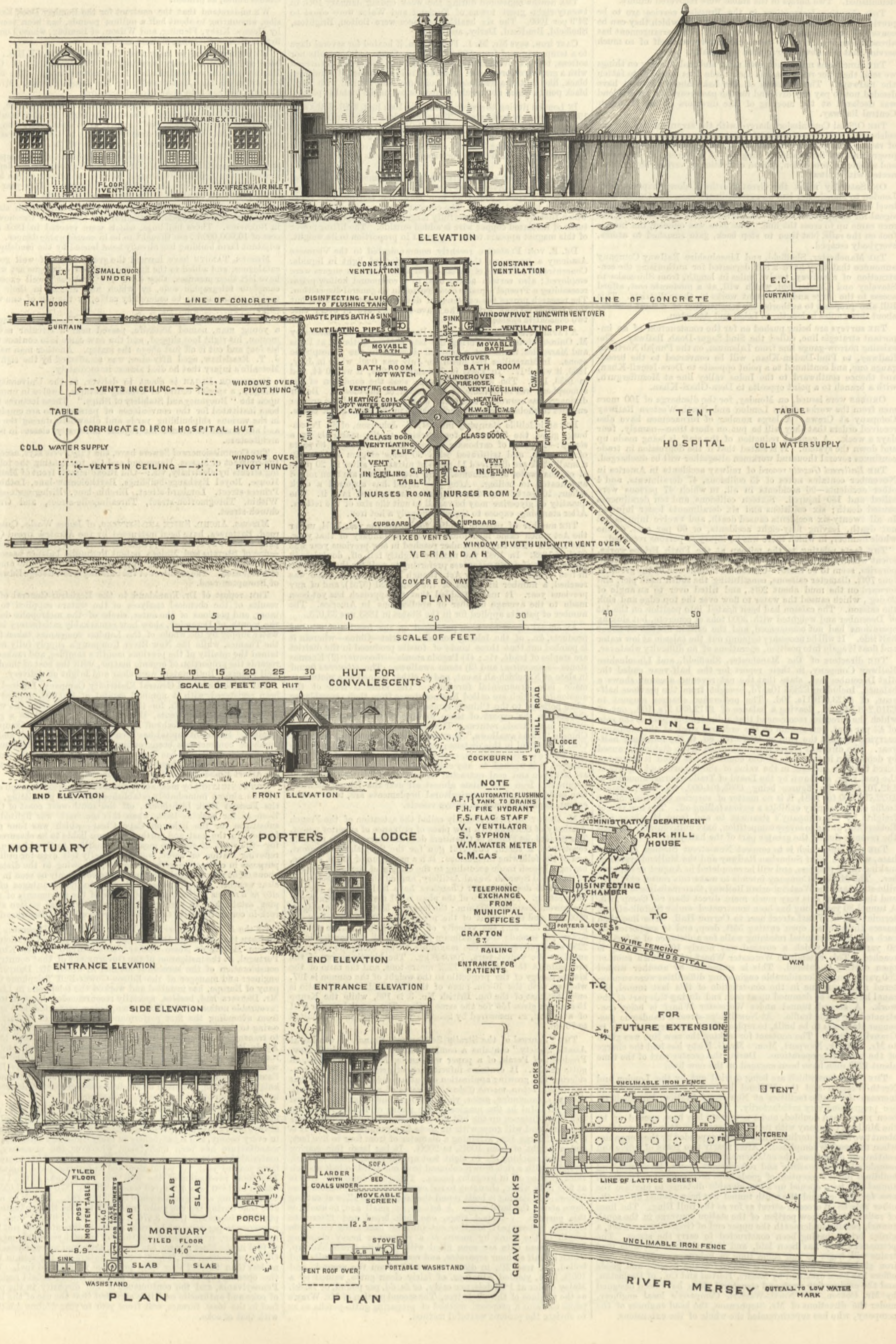
COMMUNICATION by means of a submarine electric telegraph cable will be almost immediately established, weather permitting, with the Fastnet Rock Lighthouse, off the south-west coast of Cork. Even as far back as 1854, when this sea-mark was lighted as a substitute for the light on Cape Clear—which was four miles further to the east and north, and more liable to be obscured by fog—the want of effective means of signalling to Crookhaven, the relieving station on shore, was occasionally felt even for ordinary purposes in connection with the service, as, owing to the distance, about eight miles, signal flags and lights could only be seen in very clear weather. Lloyd's recently, looking to the advantages of the site as a means of obtaining intelligence of the movements of shipping, established, by permission, an ordinary signal station at the rock in connection with the adjacent promontory of Browhead.

BY the *Diario do Governo* of Lisbon of the 26th December last, we learn that Mr. Alan Danvers has been gazetted a Cavalleiro da Ordem Militar de Nosso Seahar Jesus Christo by the King of Portugal, at the instigation of the Government of that country, in consideration of the successful manner in which Mr. Danvers, as engineer and manager of the Edison-Gower-Bell Telephone Company of Europe, has installed and worked the telephone in Lisbon. Mr. Danvers had, besides, specially recommended himself to the favourable notice of the King when, being prevented last spring from attending the first performance of the opera "Lauriana" owing to the death of the Princess of Saxony, Mr. Danvers offered to transmit the opera by telephone from the Opera House to the Ajuda Palace. This proposal was graciously accepted, and the result proved most satisfactory, as both the music and the words were distinctly heard by the King and members of the Royal Family. This is, we believe, the first instance of the honour of knighthood being conferred on a telephone engineer for his services in that branch of the engineering profession.

IN a recent official report on the American iron and steel industry, it is stated that the manufacture of iron and steel has always been a favourite pursuit among the Americans, and primarily in every colony, and subsequently in every State and territory, this manufacture has been undertaken wherever the necessary raw materials have been found to exist. The products have increased from year to year, as population and enterprise have increased. The total production of the iron and steel works of the United States in 1880 was 7,256,140 tons, while in 1870 it was 3,655,215 tons, showing an augmentation of 98·76 per cent. It may be noted also that during the five years from 1879 to 1883 the production of pig iron increased from 3,070,875 tons to 5,146,972 tons. In reference to pig iron made with mixed anthracite coal and bituminous coke, it is pointed out that for several years this mixture of fuel in the blast furnace has become more and more satisfactory. Of the production of 1,885,596 tons of anthracite pig iron in 1883, no less than 920,142 tons were produced with mixed fuel. With the opening up of a new coke field in the Clearfield region of Pennsylvania, and the continuance of the disparity in the prices of coke and anthracite coal, it is expected that the use of the latter fuel in the blast furnace will from year to year decline relatively with that of coke.

PARK HILL HOSPITAL, LIVERPOOL.

MR. CLEMENT DUNSCOMBE, M.I.C.E., ENGINEER.



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WE are indebted to Mr. Clement Dunscombe, city engineer, Liverpool, for the following description of a hospital erected last year at Liverpool, and especially interesting from the novelty of its construction, and the rapidity of its erection:—

The site which comprises the Park Hill Estate, 20 acres in extent, has a south-west aspect, and is at a moderate elevation sloping quickly to the river Mersey, the encampment being between the 70ft. and 50ft. contours, the levels being reduced to Old Dock Sill, which is 4·2ft. below Ordnance Datum. It is situated in the township of Toxteth Park, within the city limits, and is most admirably adapted for the purpose, both as regards its position and surroundings. Park Hill House has been utilised as the administrative block in connection with the encampment as shown upon the plan; the out-offices attached thereto have been converted into a steam laundry, disinfecting chamber, stores, ambulance shed, &c., while the mansion house proper has been fitted up for the use of the administrative staff. The approach to the administrative block of buildings is by Cockburn-street or South Hill-road, and to the hospital encampment by Grafton-street. The disposition of the hospital on the site was restricted to the land on the north side of the new road leading from the Grafton-street entrance to the encampment. This necessitated the erection of the hospital on one side of the road only, as already referred to. The hospital occupies a site 460ft. by 220ft. This area has been carefully underdrained, and two terraces formed 410ft. by 40ft. The tents and buildings stand upon a Portland cement concrete foundation, 6in. deep, laid over the entire area of these terraces, upon which the joists carrying the floors of the tents and buildings rest, adequate ventilation under the same being secured. The encampment consists of four pairs of double hospital tents of the most recent pattern, and two pairs of iron buildings. Each pair of tents and buildings are connected by a building consisting of nurses' day rooms, bath-rooms, closets, &c. A covered footway, 9ft. wide, traverses the centre of the encampment, with similar covered ways right and left to each of the blocks of buildings placed between each pair of tents or iron buildings. The footway is formed of 6in. of Portland cement concrete laid on a suitable foundation. The covering of this footway is constructed of wood and roofed with 4-ply Willesden paper painted light green, the rafters, posts, and battens on roof being finished in chocolate. The roof at entrance over roadway is similarly treated. On the south side of the entrance there is provided a kitchen 20ft. by 16ft. by 15ft. 6in. in height, and a scullery 18ft. by 14ft. by 15ft. 6in. in height; larder, 14ft. 6in. by 10ft. 6in. by 10ft. in height; airing-room, 9ft. by 7ft. by 10ft. high; and a dry earth store, 7ft. by 5ft. by 10ft. in height. The airing-room and dry earth store are heated by steam pipes from a boiler fixed in the kitchen. The kitchen, scullery, airing-room, and dry earth store are built in red brick, tuck pointed, with blue brick dressings. The kitchen is fitted with complete steam and other cooking appliances, sufficient for 200 patients. The larder and store-room are framed buildings, covered in Willesden paper, match-boarded on the inside, and finished similarly to the buildings described further on. The connecting block, situated between each pair of tents or huts in the encampment, is built in the bungalow style, with a verandah in front, and consists of wooden framing covered with No. 4-ply Willesden paper, lined inside with grooved and tongued match-boarding; the space between the outside covering and inside lining being filled in with silicated cotton, and the woodwork finished internally with asbestos fireproof paint. The Willesden paper is painted light-green and the battens chocolate. Each connecting block contains two nurses' rooms and two bath-rooms, each 12ft. 6in. by 11ft. 3in., and 11ft. 3in. by 9ft. 3in. respectively, and 12ft. 6in. high. A lobby, 5ft. wide, provided with through ventilation, divides each hospital ward. Doors, with top panels glazed, are provided in each nurses' room, to act as inspection windows for the wards. At the rear of each bath-room there is a slop sink, discharging external to the building, and provided with hot and cold water supplies, placed in a lobby with through ventilation; and beyond are earth closets, 5ft. by 3ft., provided with constant through ventilation, and pivot-hung windows, 2ft. 3in. by 1ft. 2in. The other windows are 6ft. by 2ft. 9in., and are pivot-hung. The corrugated iron hospital huts are 52ft. by 25ft., and 14ft. average height. The iron roofing is laid on boarding, and internally the walls are boarded with grooved and tongued boarding, the space between them being filled, as in the other blocks, with silicated cotton. The roof is ceiled up the rafters with four-ply Willesden paper, the intervening space being also filled with wired silicated cotton, about $1\frac{1}{2}$in. thick. The walls are finished in two coats of asbestos fireproof paint. There are sixteen windows in each ward—twelve side windows, 5ft. by 3ft. 9in., and four end windows, 3ft. 9in. by 3ft. 6in. Adequate cross ventilation is secured. The whole area of the windows is made to open, the top sashes being pivot-hung. In every case there is a free current of air under the floors, and fresh air is admitted into the wards through a sufficient number of conical air-bricks. Exit ventilators are provided near the ceiling line and by means of louvres fixed in the roofs. At the end of the encampment a hut for convalescents is provided, 40ft. by 12ft. and 12ft. in height, constructed of wood framing, covered with Willesden paper and lined with grooved and tongued boarding, and finished in the same manner as before described. The space in front is laid out as a garden. In fine weather this hut can be used as a reading and recreation room. The porter's lodge, 12ft. 3in. by 12ft. 3in. and 11ft. in height, is situated at the Grafton-street entrance, and is a wooden-framed building, covered with Willesden paper and painted green, with battens chocolate, and finished internally the same as the other buildings. The mortuary and post-mortem room—the former 14ft. by 14ft., and the latter 14ft. by 9ft., each 11ft. to ridge—are similarly constructed, viz., wooden framing, covered with Willesden paper externally and internally, and grooved and tongued boarding, the roof being ceiled with Willesden paper. The walls and ceilings are finished in green, with a chocolate dado, and the rafters are dressed and similarly painted. The mortuary is provided with rubbed slate shelves, supported on blue brick, tuck-pointed piers. The floor is finished in best black and white tiles on 4in. Portland cement concrete. The post-mortem room has ample top light, and is similarly finished, except that the dado consists of 6in. glazed and enamelled white tiles. There is provided a slate post-mortem table, slate sink, with hot and cold water supplies, &c.

THE MORTUARY, PARK HILL HOSPITAL.

Water supply.—A constant service supply is provided throughout the encampment, slate storage cisterns being provided for supplying the hot water cylinders which supply the baths throughout. In each hut and building, and also in the nurses' rooms, there is provided a drinking supply direct from the main, and a fire supply, with hose attached, ready for use. Hydrants, with hose ready attached, are also provided in suitable positions along the covered ways. The hot water supply for each block is obtained by means of coil gates fixed in each of the bath-rooms, and these, while acting as an ordinary open fire grate, the fire-bars of which form portion of the coil, supply through the hot water cylinder fixed over each pair of bath-rooms an adequate and continuous supply of hot water.

Drainage.—The drainage has been most carefully attended to, and forms as complete a system as could be devised. A reference to the plan will show the arrangement. The whole of the drainage is external to the buildings; the sinks, wastes, &c., emptying over external traps. The drains are adequately ventilated, suitable inlets and outlets being provided. Disconnecting chambers are constructed to sever any connection with the drainage from the hospital, mortuary, &c., and the administrative block. The drains, which consist of glazed earthenware pipes, caulked and jointed in Portland cement, finally discharge through a 9in. pipe into the river Mersey at low-water mark. There is, therefore, no connection with the drains from the hospital and the sewers of the city, the hospital, so to speak, having an independent outfall.

Flushing and disinfecting arrangements.—The provision in this respect is complete. At the head of the drains from each block an automatic flush tank of simple construction is provided, which is filled by a tap at a given time. Six hours has been fixed in this case. A small tank, containing carbolic acid, is fixed where shown on plan, near each flush tank, and communicating therewith. This tank discharges a given quantity of carbolic acid automatically into the flush tank, and when this is full the syphon comes into operation, and the contents of the flush tank, about 40 gallons, consisting of a powerful disinfecting solution, is discharged from the head of each drain. The same arrangements are provided at the mortuary, post-mortem room, kitchen, &c. In the case of the kitchens and mortuary, grease interceptors are provided in the flush tanks. It will be seen, therefore, that the whole of the drains are automatically flushed with a disinfecting solution four times every twenty-four hours. The value of so complete and perfect a system of drainage acting automatically cannot be over-estimated in an hospital designed for infectious diseases.

Heating arrangements.—It is intended to heat the tents and iron building by means of a specially-designed circular open fire grate in the centre of each ward or tent, the fire bars forming portion of a coil placed centrally at back of fireplace, with a steam pipe from same running round the ward or tent, special provision being made for this to act as a ventilator. By this means an equable ward temperature is secured.

Lighting.—Gas is laid on throughout the buildings, tents, and covered ways. The brackets are in every case fixed and supplied with enamelled steel cowls, acting as reflectors.

Telephonic communication.—Telephonic communication is established from the telephone exchange in the City Engineer's Office, Municipal Offices, to the Medical Officer of Health's Office, and Park Hill House (Administrative Department), the Porter's Lodge, and the Encampment. Triangular communication, as shown on the plan, is also established, which provides telephonic communication between the Medical Officer of Health's Office, or the City Engineer's Office, and Park Hill House, the Porter's Lodge, or the Encampment proper. There is a telephone office on the west side of the verandah attached to the kitchen, by which, in case of emergency, communication can be made to the Resident Medical Officer at Park Hill House, or with the Municipal Offices. The porter, from his lodge, can likewise communicate with the medical staff at the Park Hill House, or with the Encampment, on the arrival of a patient. By this means no time is lost in either dealing with a patient on arrival, or answering any questions from the Municipal Offices relative to patients.

Wind screen.—Owing to this site being exposed to the prevailing winds, which vary from south to north-west, and it being also exposed to the river Mersey on the south-west side, it was considered advisable to protect the Encampment from these winds. The construction designed for the purpose is both a novel and most effective arrangement. It is 600ft. in length and 30ft. in height, and consists of Norway poles, placed 6ft. apart, to which are fixed battens at intervals of 15in., laths being interlaced between the same, forming a screen which most effectually breaks the force of the greatest hurricane. The screen is carefully braced and stayed with steel wire ropes, and it, and the tents and buildings, are well secured by steel wire ropes to ground anchors. Behind the screen there is formed a footpath, 5ft. wide, for the use of convalescents. The Encampment is enclosed with wrought iron unclimbable fencing, and wire fencing on each side of the road leading thereto, and also along the river frontage. The lower grounds have walks laid out through them for the use of convalescents; the quadrangles formed by the covered ways are laid down in grass, relieved by flower beds and shrubs. The hospital is generally supplied with all the furniture, fittings, and appliances of the most perfect and complete description necessary for the requirements of the best appointed hospital. All the requisite accessories which tend to render an hospital complete in every detail have been provided, such as steam laundry, disinfecting stoves, mortuary, post-mortem room, brougham ambulance of the latest construction. The furniture, which is polished pine throughout, has been specially designed, and also the fittings—all plain, easily cleaned, and specially adapted for the purposes for which they are applied. No unnecessary outlay has been incurred. The aim, however, has been to provide a temporary hospital second to none as regards its completeness in every detail, and one which will be readily availed of by those unable to provide proper isolation or medical care for patients in their own houses. The Encampment and its surroundings are made as attractive-looking as possible, and are a marked contrast to what is too frequently designated as a temporary infectious hospital, and which in many cases consists of a repulsive-looking aggregation of wooden sheds. As an evidence of the care taken in the designing of the buildings, and also in providing an adequate constant service water supply and all requisite fire appliances, it may be mentioned that the fire risk over the Encampment is covered by a responsible fire office at the low rate of 3s. 6d. per cent. The total cost of the hospital, complete in every respect, has been £11,870. This is exclusive of the value of the site or Park Hill House, which has been utilised for the administrative staff, but is inclusive of all furniture, fittings, and other appliances of every description. It was erected ready for use within two months, although the preparation of the ground, water supply, drainage, concreting the site, has entailed considerable labour, 300 men having been constantly employed for that period upon the works.

ECONOMICAL STEAM TRAMWAY.—The Dewsbury, Batley, and Birstal Steam Tramways—the first ever constructed in England—worked by Merryweather 7in. engines, show in the half-year's working accounts that the total cost of the running of the engines is 2·57 pence per mile, and the total expenses of the whole establishment, including locomotive charges, 5·16 pence per mile. This is one of the most economically-worked lines in the country.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending Jan. 10th, 1885:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 11,189; mercantile marine, Indian section, and other collections, 2911. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 4 p.m., Museum, 1311; mercantile marine, Indian section, and other collections, 167. Total, 15,578. Average of corresponding week in former years, 18,098. Total from the opening of the Museum, 23,660,949.

THE INSTITUTION OF CIVIL ENGINEERS.

PRESIDENT'S ADDRESS.

AT the meeting on Tuesday, the 13th of January, Sir Frederick J. Bramwell, F.R.S., delivered an address on his election as President.

He stated that he had been determined in his choice of a subject by the consideration that H.R.H. the Prince of Wales had seen fit to appoint him Chairman of the Executive Council of the International Inventions Exhibition, to be held at South Kensington this year. He therefore proposed to direct attention to some of those objects that ought to be contributed to that Exhibition, which were more particularly connected with civil engineering.

Dealing first with materials of construction, the President remarked that probably few materials had been more generally useful to the civil engineer, in works which were not of metal, than Portland cement. During the last twenty-two years great improvements had been made in the grinding and in the quality of the cement. As regards bricks, although not now superior in quality to those made by the Romans, there was progress to be noted in the mode of manufacture and the materials employed. The brick-making machine and the Hofmann kiln had economised labour and fuel, while attempts were being made to utilise the waste of slate quarries. Certain artificial stones appeared at last to be produced with such a uniformity and power of endurance as to compare favourably with the best natural stone, or were even better, for they could be produced of the desired dimensions and shape, and were thus ready for use, without labour of preparation. The employment of wood, except in newly-developed countries, was decreasing, for one reason, because it was practically impossible so to use it as to obtain anything approaching to the full tensile strength. Many attempts had been made to render timber proof against rapid decay and ready ignition, and it was in these directions alone that progress could be looked for. With respect to preservation from fire, the wooden structures of the Health Exhibition were coated with asbestos paint, and to this their escape from destruction by a fire was due. Leaving the old-world materials of stone and wood, attention was directed to that form of iron known as steel. The President remarked that, in his judgment, the making of steel in crucibles was not so satisfactory a mode of obtaining uniformity in large masses as was either of the other two great systems of manufacture—the Bessemer and the Siemens—the two processes which had changed the whole complexion of the iron industry. He further said that, eight years ago, in a lecture he delivered at the Royal Institution, he had ventured to predict that steel made by fusion would supersede iron made by the puddling process, and that the use of iron so made would be restricted to the small articles produced by the village blacksmith. The first important revelation in steel manufacture was the ingots shown by Krupp, with other products, in the Great Exhibition of 1851. These showed an enormous step at the time when the production of steel involved the employment of the crucible. Within the last eight years a great improvement had been made by Messrs. Thomas and Gilchrist, by which it had been rendered possible to employ successfully, in the production of steel, iron derived from ores that, prior to the date of this invention, had been found wholly inapplicable for the purpose. In the manufacture of pig iron improvement had been effected by increasing the dimensions of the furnaces and the temperature of the blast, by the better application of chemistry to the industry, by the total closing of the bottom of the furnace, and by the greater use of the waste gases. Copper, so long used in its alloyed condition of "gun-metal," had, within the last few years, been still further improved by alloying it with other substances so as to produce phosphor-bronze and manganese-bronze, very useful materials to those engaged in the construction of machinery. With the increased dimensions of the main shafts of engines, and of the solid forgings for the tubes of cannon, obtaining at the present day, composed, as they were, of steel, the operations of light steam hammers were absolutely harmful, and the blows of even the heaviest hammers were not so efficacious as was pressure applied without blow. The time was not far distant when all steel in its molten state would be subjected to pressure, with the object of diminishing the size of any cavities containing imprisoned gases.

Within the period under consideration, the employment of testing machines had come into the daily practice of the engineer, for determining, experimentally, the various physical properties of materials—and of those materials when assembled into forms to resist strain, as in columns or in girders. In those matters which might be said to involve the principles of engineering construction, there must of necessity be but little progress to note. Principles were generally very soon determined, and progress ensued, not by additions to the principles, but by improvement in the methods of giving to those principles a practical shape, or by combining in one structure principles of construction which had hitherto been used apart.

Taking up, first, the subject of bridge construction—the President thought the St. Louis Bridge might fairly be said to embody a principle, novel since 1862, that of employing for the arch ribs tubes composed of steel staves hooped together. Further, in suspension bridges, there had been introduced the light upper chain, from which were suspended the linked truss-rods, doing the actual work of supporting the load, the rods being maintained in straight lines, and without flexure at the joints due to their weight. In the East River Bridge at New York, the wire cables were not made as untwisted cables, and then hoisted into place, imposing severe strains upon many of the wires, but the individual wires were led over from side to side, each having the same initial strain. So far as novelty in girder construction was concerned, the suspended cantilever of the Forth Bridge, now in course of construction, afforded the most notable instance. It was difficult to see how a rigid bridge, with 1700ft. spans, and with the necessity for so much clear headway below, could have been devised without the application of this principle. A noteworthy example of the use of pneumatic appliances in cylinder-sinking for foundations was also in progress at the Forth Bridge. At the New Tay Viaduct, the cylinders were being sunk while being guided through wrought iron pontoons, which were floated to their berths and were then secured at the desired spot by the protrusion, hydraulically on four legs, which bore upon the bottom, and they, until they were withdrawn, converted the pontoon from a floating into a fixed structure. The President next traced the contest between canals and canalised rivers as modes of internal transit in contrast with railways, and referred to the improved rate of transport on canals by the substitution of steam for horse-haulage, and by a diminution in the number of lockages. He also alluded to the hydraulic canal lift on the river Weaver, and to a similar application in the Canal de Neufossé, in France, for overcoming a great difference of level, and reducing the consumption of water and the expenditure of time to a minimum. The great feature, however, of late years in canal engineering, was not the preservation, or improvement, of the ordinary internal canal, but the provision of canals such as the completed Suez Canal, the Panama Canal in course of construction, the contemplated Isthmus of Corinth Canal—all for saving circuitous journeys in passing from one sea to another—or in the case of the Manchester Ship Canal, for taking ocean steamers many miles inland. The rivalry between canal engineers and railway engineers was illustrated by the proposal to connect the Atlantic and Pacific Oceans by means of a ship railway, the details of which scheme were before the public.

In harbour construction, the principle adopted in the Liffey at Dublin was referred to, where cement masonry was moulded into the form of the wall, for its whole height and thickness, and for such a length forward as could be admitted, having regard to the practical limit of the weight of the block. The block was then carried to its place, was lowered on to the bottom, which had been prepared to receive it, and was secured to the wall by groove and tongue. The apparatus by which the blocks, weighing 350 tons each, were raised and transported to their destination, was then described.

Consideration of sub-aqueous works necessarily led to appliances for diving; and here the President said a few words about the "bateau-plongeur," used on the "barrage" of the Nile. Beyond improvement in detail and the application of the telephone, there was probably no novelty to record in the ordinary dress of the diver. But one great step has been made in the diver's art by the introduction of the chemical system of respiration. A perfectly portable apparatus has been devised, embracing a chemical filter, by which the exhaled breath of the diver was deprived of its carbonic acid. The diver also carried a supply of compressed oxygen to be added to the remaining nitrogen, in substitution for that which had been burnt up in the process of respiration. Armed with this apparatus, a diver during one of the inundations which occurred in the construction of the Severn tunnel, descended into the heading, proceeded along it for some 330 yards—the depth of the water above him being 35ft.—and closed a sluice door through which the water was entering the excavations, and thus enabled the pumps to unwater the tunnel. Altogether this man was under water for one hour and twenty-five minutes, without any communication with those above.

There were, happily, cases of sub-aqueous tunnelling where the water could be dealt with by ordinary pumping power, and where the material was capable of being cut by a tunnelling machine. In the Mersey tunnel, in the new red sandstone, in a heading 7ft. 4in. in diameter, a speed of 10 yards in twenty-four hours had been averaged, while a maximum of over 14 yards had been attuined. In the experimental Channel tunnel, in a 7ft. heading in the grey chalk, a maximum speed of 24 yards had been arrived at in the twenty-four hours on the English side, and on the French side of $27\frac{1}{3}$ yards in the same time. In ordinary land tunnelling, since 1862, there had been great progress, by the substitution of dynamite, and preparations of a similar nature, for gunpowder, and by improvements in the rock drills worked by compressed air, used in making the holes into which the explosive was charged. In boring for water, and for many other purposes, the diamond drill had proved of great service. Closely connected with tunnelling machines were the machines for getting coal, which, worked by compressed air, reduced to a minimum the waste of coal, relieved the workman of a most fatiguing labour in a constrained position, and saved him from the danger to which he was exposed in the hand operation. The commercial failure of these machines was due to trade opposition; and it was to be feared that like prejudices would prevent the introduction of the lime cartridge in lieu of gunpowder.

With regard to the great source of motive power—the steam engine—it was difficult to point to any substantive novelty since 1862. But the machine had been more and more scientifically investigated, and the results had been practically applied with corresponding advantages. The increase in initial pressure, the greater range of expansion, the steam jacketting of the vessels in which the expansion took place, had all led to economy. Double-cylinder non-condensing engines were now currently produced, which worked with a consumption of only $2\frac{3}{4}$ lb. of coal per indicated horse-power, or 2·7 lb. per horse-power delivered off the crank shaft, equal to 82 millions of duty on the Cornish engine mode of computation. When these results were augmented by the employment of surface condensation, an indicated horse-power had been obtained for as low as $1\frac{1}{2}$ lb. of coal, and it was commonly obtained, in daily work, for from 2 lb. to $2\frac{1}{2}$ lb. But in the use of steam as a heat-motor, the largest portion of the heat passed away unutilised. This defect had been sought to be overcome by a regenerative steam engine, but it was not successful. Heated-air engines had hitherto only been found applicable where small power was required. Another form of heat motor—the gas engine—was daily coming iuto general use up to 30 indicated horse-power. By a change in the mode of burning the mixture, and of utilising the heat thereby generated, the injurious shock of the early forms of gas engine and their large consumption of gas were obviated. Comparing a gas engine with a non-condensing steam engine consuming 5 lb. of coal per indicated horse-power per hour, and demanding, therefore, at one shilling per cwt., only one halfpenny for the purchase of coal, the extra cost for working the gas engine was well repaid by the saving of boiler space, of the wear and tear of the renewal of the boiler, of the consumption of coal while getting up steam and during meal times, of the saving of wages, of the freedom from boiler explosions, and of the cessation of smoke production. A motor had been recently tried where no fuel was employed directly, but where a boiler, being filled with water and steam under pressure, had its heat maintained by exposing caustic soda, contained in a vessel surrounding the boiler, to the action of the waste steam from the engine, the result being that as the moisture combined with the caustic soda, sufficient heat was developed to generate steam and keep the engine working for some time. Trials had been made with this motor for propelling a launch and for working a tram-car.

With respect to other motors—viz., those driven by wind or by water—in France an improvement had been made in water-wheels by which it was asserted that 85 per cent. of all the energy residing in a low fall of water had been converted into power. In turbines, also, there had been considerable development during the last twenty-two years, and they were very efficient where a high fall of water had to be utilised, or where, in the case of a low fall, great difference in the working head, and in the level of the tail water, had to be provided for.

Next to the subject of motors came the transmission of power. In its restricted sense, the transmission from one part of a machine to another, reference might be made to the increasing use of multiple-rope driving gear in lieu of belts, to inclined spur gear for diminishing noise, and to that kind of frictional gearing to which the name of nest gearing had been given. Where, however, the transmission was to long distances, means were being adopted for supplying power, *i.e.*, water under pressure or compressed air, through mains laid down in the streets, in a manner similar to that in which gas and water were now supplied for domestic use; and in New York and other cities of the United States, high pressure steam was similarly conveyed and delivered to the consumers, both for power and for heating.

Sir Frederick Bramwell also remarked upon the continuous rolling of bars of steel for tires, upon the right way of making boiler shells and boiler flues, upon tidal motors, upon dirigible balloons, upon the Maxim machine gun, and upon the application of submarine mines and torpedoes for the defence of seaports. In regard to waterworks, he could not adduce any material improvements in those dependent upon storage, or in pumping machinery; but in the matter of house fittings there had been great progress, especially in the detection and prevention of waste of water. With respect to gas as a distributed illuminant, considerable improvements had lately been made, due to a greater liberality on the part of lighting authorities, and to the use of multiple burners in street lanterns, by which a greater amount of light was obtained from the same volume of gas. The regenerative gas burners and other modes promised largely to increase the candle-power per cubic foot of gas burnt.

In conclusion the President stated that, during his term of office, he would do all that lay in his power, as he had done in the past, to uphold the honour, the dignity, and the usefulness of the Institution; and in these efforts he felt satisfied that all the members would cheerfully and gladly assist.

THE value of the storm-signal service in force on the Canadian lakes and throughout the Dominion is shown by the recent report for 1884, wherein it is stated that out of 841 warnings issued, as many as 658 were verified.

LETTERS TO THE EDITOR.

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

DOUBLE BOGIE ENGINES.

SIR,—I beg to return you my sincere thanks for the insertion of my double bogie engine in your issue of 10th September. I have delayed writing to thank you, expecting possibly some comment upon the engine; but that from Mr. Fairlie being the only one, needs no reply.

I still think that the only way in which the wheel pressure upon the rail can be reduced to nearly that of the carriage or wagon is by the distribution of weight over a larger number of wheels, as in the double bogie engine, when small curves have to be encountered, and where the weight of rail and general cost of road is an important desideratum in countries like Victoria, far removed from manufacturing centres, and where the 5ft. 3in. gauge, so suitable for this class of engine, has been adopted.

I have not heard from any English locomotive builders who would be inclined to manufacture these engines, but would be glad to communicate with any of standing. F. C. CHRISTY.

Melbourne, December 3rd.

LOCOMOTIVE ENGINES IN PORTUGAL.

SIR,—Having read in your very interesting journal of the 29th August, 1879, an appreciation of Clark's publication, "A Rudimentary Treatise on the Locomotive Engine, etc.," approving as type of locomotive engines with inside cylinder and single wheels the engine Dom Luiz, of the firm Beyer and Peacock, that since 1862 is working on this line, I was quite astonished to see in the same appreciation the following phrase:—"In fact, the only line using a nearly similar type of engine is the Great Northern; but the Great Northern engines have their leading wheels much further forward than they are, or rather were, in the Dom Luiz, which probably went to the scrap heap some years ago, for they do not take quite such good care of locomotives in Portugal as they do in England." Hereon, allow me the information that the engine Dom Luiz not only didn't go to the scrap heap as you believe, but is yet in active service, having driven express trains the 3rd and 7th inst. between Barreiro and Alvitos station, situated at a distance of 124 kilometres, carrying the King and Royal Prince, as well as their suite, to a hunting party.

I have also a great satisfaction in telling you that six of the first locomotive engines that came in 1857 for this line, the first constructed in Portugal, are yet working, notwithstanding a constant and hard work of twenty-seven years, while during a great part of this period no others existed. This shows clearly that in Portugal as well as in England all care is taken in the preservation of the locomotive engine.

Begging to ask you the publication of this letter in the next number of your paper, allow me to present you the protests of my highest esteem and consideration.

MIGUET CARLOS CORREIA PAES,
The Engineer-in-Chief of the Exploration.

Barreiro, December 30th, 1884.

COOPER'S HILL COLLEGE.

SIR,—Professor Shaw, in his letter in your issue of January 2nd, denies point blank the correctness of my assertion that India, and not Britain, pays every penny of any deficits occurring through the working of the College. In support of his assumption to the contrary, he quotes a passage from the report of the Royal Commissioners. If he will examine this again he will find he has read it in an entirely unnatural sense. It in no way asserts the College to be no longer maintained by India, much less to be supported by Britain. The passage, in fact, asserts no more than whereas formerly the College was maintained solely for the education of Indian Government engineers, it is now thrown open to the public. This, of course, has been done, not as Professor Shaw would have us believe, with the result of the Government of India having to pay for the education of other engineers in addition to its own—which latter it had already objected to—but expressly for making the College self-supporting, and so getting rid of the objectionable charges incurred in training its own men.

If Professor Shaw does not deem my assertion to be strictly correct, it is for him to authoritatively refute it. Let him address the Secretary of State for India on the subject, and publish his reply in these columns. I shall certainly not occupy my time or your space in attempting to substantiate an assertion which so far needs nothing of the sort. When Professor Shaw proves it wrong I will withdraw it. When did Parliament sanction any grant in aid to the College? Let him answer this question, which goes to the root of the matter.

I may add that in addition to this matter of who pays the deficits, Professor Shaw should first assure himself that deficits still occur in spite of the altered status of the College. Otherwise he may find that he has been but begging the question and creating a grievance where none exists. "Cooper's Hill on Furlough," in his letter of December 5th, tells us that at the first the College was self-supporting, and will be so whenever it is full—that is, has 150 pupils and upwards. I know nothing about this; but I observe that Professor Shaw has not contradicted the correctness of this statement.

In spite of Professor Shaw's dislike to the inconvenient assertions of anonymous correspondents, and having, unlike him, no rival College to advertise by using my own name, I still prefer, with your permission, to subscribe myself as IMPARTIAL.

January 9th.

RAILWAY PASSENGER TRAFFIC.

SIR,—Last week, page 27, Mr. F. T. Haggard published some tabulated statements in support of his well-known and frequently expressed views against the Midland Company's policy of conveying third-class passengers by all trains at a fare of one penny per mile. For many years only first and second-class passengers were conveyed by fast trains, the third-class traffic being practically discouraged in the hope that it might be forced into carriages of a superior class at higher fares. In practice, however, it was found that although a small proportion of persons were forced to ride second-class, a very large number was compelled to stay at home and not travel at all. The folly of that policy was well known to Mr. Allport, of the Midland Railway, and upon 1st April, 1872, that company conferred a very great boon upon the travelling public by attaching third-class carriages to every train. This important change very soon proved that the cheap passengers, who had been despised and discouraged, actually paid better than either the first or second classes, which had been so specially accommodated and encouraged. At half-yearly meetings the chairmen of several railways complain of the decline of first-class traffic. Mr. Moon at Euston remarked:—"We find that gentlemen of the first position take third-clase tickets; all he hoped was they would have sweeps or navvies riding with them."

At the time when the first and second-class traffic flourished the passengers paid higher fares, not only for better carriages, but for increased speed. The higher charge no doubt repaid the passengers in the shape of valuable time saved in travelling. It will be seen that the first-class passengers do not now obtain any extra speed for their extra money; and the question resolves itself simply into this—Will passengers pay two or three pence per mile to sit in a first-class carriage, when for one penny they can ride perhaps in the next compartment of the same vehicle? So far as the Midland is concerned, the answer is decidedly, No; and the decline of first-class on many other lines furnishes a similar reply. There can be no doubt that either the first-class fares must very soon be lowered, or the large number of empty first-class carriages now to be seen on many lines must be taken off the trains, as they are fast becoming useless dead weight, which has to be dragged about the country at great cost. Mr. Haggard, in his table of traffic during the year 1883, gives only the total receipts from the three classes. Now, it appears to me this information should have been given separately. The following figures show the total receipts for the year 1883 upon the railways of the United Kingdom:—

Passenger traffic.	Number of journeys.	Receipts in £
First-class passengers	36,387,877	3,670,053
Second-class passengers	66,096,784	3,329,744
Third-class passengers	581,233,476	17,050,064
Season tickets (632,050)	—	1,692,591
Excess luggage, mails, &c.	—	3,766,281
Total	683,718,137	29,508,733

These figures show at a glance that the third-class is the mainstay of the traffic. Comparisons are frequently made between the years 1873 and 1883. It should be pointed out that this is hardly fair, as the years 1871-2-3 were extremely prosperous, whereas for a long time past there has been, and still is, great commercial depression. However, it is very satisfactory to find that the passenger receipts per "mile of line open" have increased from £1483 in 1873 to £1580 in 1883, and the total receipts have also increased from £3462 per "mile open" in 1873 to £3651 in 1883. In both cases the receipts were higher in the year 1883 than during any of the ten previous years.

In consequence of severe competition, there is no doubt the railway companies are now giving much more accommodation to the public than they did ten or twelve years ago; but still it is a pleasing fact that, as regards ordinary capital, the rate of dividend was equal to an average of £4·68 per cent. per annum during 1883, this rate being very nearly the highest which has been paid for ten years.

Within the past few days a suggestion has been made that shareholders should induce the directors of the seven leading lines to hold a conference with a view to "obtaining a fair return for work performed," which, in other words, means augmented fares. It is not likely that such a conference will be held, nor that it would ever recommend such a retrograde movement; and it is quite certain that the Midland Company would never agree to alter its present "third-class policy" with which it is perfectly satisfied, just because it is not advantageous to six other competing lines.

Mr. Haggard appears to take a very desponding view of the future of passenger traffic, which the facts do not seem to warrant. It is sincerely to be hoped that the present depression in trade will soon pass by; but in any case, I still maintain the opinion that the only true policy is to encourage, increase, and develope to the utmost the third-class traffic. CLEMENT E. STRETTON.

40, Saxe-Coburg-street, Leicester, Jan. 10th.

THE EFFICIENCY OF FANS.

SIR,—As Professor Smith's letter had no object, if not to show that Professor Herschel was wrong, and as my letter was intended to show that the reverse was true, I fail to see any misapprehension in taking Professor Smith's strictures to apply to myself. I can, however, readily suppose that Professor Smith has even now not read my letters, his references to them being without exception inaccurate.

By mixing up the cases in which the variation of pressure is not very small with those in which it is very small, Professor Smith makes some kind of a defence. It is, however, entirely untrue that the difference between us is that "he takes isothermal and I take adiabatic expansion (compression, I suppose, is meant) as approximating most nearly to the actual thermal conditions under which fans work." I have nowhere assumed that the fan works isothermally, but very much the reverse. In spite of Professor Smith's doubts, the conversion of the waste work into heat does take place within the fan case, and his opinion as to the friction of the air affecting the thermometer cannot, I suppose, be taken seriously. W. C. UNWIN.

January 12th, 1885.

FORCED COMBUSTION AT SEA.

SIR,—I have just happened to notice in your review of the engineering events of last year, contained in your issue of the 2nd instant, your remarks on my system of forced combustion as applied to the steamer New York City. It would have been unnecessary for me to have taken notice of these remarks but for the singular mistake made in saying, "She works with a closed stoke-hole." As my system is distinctly opposed to the closed stoke-hole system of forced combustion, I trust you will allow me space to make this correction on your review, with a few explanatory remarks bearing on the points of difference. In the paper read at the Institution of Naval Architects last year, I stated that the closed stoke-hole system, while creating an unnecessary complication in having the boilers fitted in air-tight rooms, was, besides, wasteful in fuel, and injurious to the boilers when the combustion was forced to any considerable extent beyond that obtainable by natural draught. These objectionable results are not only what may be expected in such cases from the conditions under which the air is in this system applied, but they have also invariably appeared in practice whenever a high power has been attempted. This system of working with closed stoke-holes, so far as I know, has, however, only been used with boilers and grate surfaces of the usual dimensions required to supply the steam wanted by natural draught combustion. When, therefore, just as much air is supplied to the closed stoke-hole as will urge the large fires to the extent obtainable by the most favourable conditions of natural draught, the defects which I have mentioned are not developed; but for working under such circumstances there is little to justify the application of an expensive complication of this nature. The only cases on record, so far as I am aware, in which the working of the closed stoke-hole system has been fairly tested, are those of the trials of H.M.S. Satellite and Conqueror, as recorded by Mr. Butler in his paper read before the Institution of Naval Architects in 1883.

The highest record obtained on these trials was 16·9 indicated horse-power from each square foot of fire-grate. This increase of power was, however, only realised by a great sacrifice of fuel, and with visible indications of injury to the boilers, even after a trial of only a few hours. I may therefore fairly object to my system of combustion being described by you as one with a closed stoke-hole. The stoke-hole used by me is an ordinary open one. In the trial of the New York City steam was maintained, not only with ease at the rate of 20 indicated horse-power per square foot of fire-grate, but with a singularly high economy in fuel, and without the slightest injury to the boiler.

With your permission I will take this opportunity of objecting to your further statement that my paper read at the Institution of Naval Architects last year on this subject was severely criticised on account of its vagueness. I need only refer your readers to the printed report of the discussion on my paper in the "Transactions" of that Institution to show how far your statement is from being correct. The only severe criticism on my paper that I know of was that of THE ENGINEER, but I am quite content to believe that this arose from insufficient knowledge on the part of the writer, and to refer your readers to my letters which appeared at the time in your pages. JAMES HOWDEN.

Glasgow, January 13th.

CONTINUITY IN PATENT LAW.

SIR,—Your cordial recognition of the importance of the question as to the alteration of claims in specifications required under the authority of the Comptroller, induces me to send you a further communication on the subject. Although I have not hitherto had any special reason to complain of the action of the Examiners, yet looking to the great consequences that may be involved in requiring alterations to be made in claims, it appears to me that it becomes essential to inquire how far the Act gives any sanction to the official requirement of alterations. In section 5, sub-section 5, it is said, "a complete specification must end with a distinct statement of the invention claimed;" and in section 9 (1), the examiner has to "ascertain whether the complete specification has been prepared in the prescribed manner." It would appear, therefore, that the whole function of the Examiner as regards claims is to see that in each case they contain "a distinct statement of the invention claimed." And the point to be determined is whether he is hereby empowered to require alterations to be made on any other ground than to remove indistinctness from such statement. Then in the case of "a complete specification being left after a provisional specification," the Examiner has to see "whether the invention particularly described in the complete specification is substantially the same as that which is described in the provisional specification." These two points—(1) distinctness of statement; (2) agreement of both specifications—appear to constitute all that the Examiner is empowered to inquire into. So that if "it is the practice of the Comptroller, not only to require very large alterations in claims, but also to send cut-and-dry claims to applicants for their approval," it is difficult to see what sanction there is under the Act for any such practice. It appears to me that if any applicant be required to alter his claim in such a manner as to be different from what he has been advised to make it, he ought to be allowed to plead his own form of claim in a court of law.

Very much often turns on a slight alteration in the wording of a claim. I remember being told by the plaintiff's solicitor in the case of Elliott *v.* Aston—1840—that it cost £1000 to determine the sense in which the word "or" was to be construed in one of the claims. In my little work "On the Specification," published in 1847, I made the following remark:—"The claim rightly understood is in fact the specification; but then in order that it may be rightly understood, reference must be had to the antecedent matter; and it may indeed be said that the intelligibility of the whole specification greatly depends upon the particular interpretation of the claim which is suggested by such reference." I may mention that in a favourable review of the work that appeared in the *Jurist* at the time, the above quotation was specially noticed.

My subsequent experience of nearly forty years has not altered my opinion as to the effect of a particular interpretation of the claim on the construction of the whole document. And it will be readily understood that for this reason I attach great importance to a reasonable amount of freedom being allowed to applicants in the wording of their claims—as they may be advised—more especially as they have to take the risk of the construction that may be put upon them by the Court. WILLIAM SPENCE.

8, Quality-court, Chancery-lane, W.C., Jan. 13th.

SIR,—Your foot-note to Mr. Wm. Spence's letter in last week's issue, questioning the right of the Patent-office examiners to alter the claims of a specification, encourages me to ask permission for bringing before you another little self-willed action on the part of the Patent-office which, I think, requires ventilation.

A few months ago I had occasion to apply for a patent in the ordinary way through some eminent patent agents. Most technical papers publish these applications as they appear in the "Journal," some, like your own, mentioning only the town in which the patentee resides, others publishing his full address. From the latter I learned, somewhat to my surprise, that my correct address had been suppressed, and that of my patent agents established for it. On inquiring into the matter, I was informed that my proper address had been handed in with the application, but that—"The Patent-office now publishes the address of the agents, and not that of the applicants, with the view to save the latter from being deluged with circulars offering to complete the patent and to take out foreign patents . . . . . which was found to be such a grievance to applicants and their agents."

Now, this seems to me a most grandmotherly bit of careful consideration on the part of the Patent-office. True, there may be some patentees who may object to the publication of their addresses, and there may be a few agents who may benefit through the change. But should not the applicants' wishes be ascertained in the first instance? I, for one, personally object to the deliberate misdirection of any information intended for me, be it contained in circulars, price lists, catalogues, letters, or documents of any kind. And I suppose most agents will also object, because it places them in a somewhat invidious position towards their clients. I shall be glad to learn what others have to say on the matter, and hope this may lead to a change. PATENTEE.

London, January 12th.

THE ROCKET.

SIR,—Referring to the note you have appended to the foot of my last letter *re* the Rocket in your issue of January 9th, I quite understand that it is admitted on all hands that a Rocket assisted in the opening of the Liverpool and Manchester Railway, but that it is argued by some that it was not the Rainhill Rocket built in 1829. Now, no one could make such a statement as a mere guess or conjecture, and therefore whoever makes it should be able to support it by evidence and proofs, about which there could not be the slightest possible doubt in anyone's mind, and which could not possibly be controverted in any way. I have seen no such evidence. I say again that the Rocket built in 1829, which won the Rainhill trial, was the identical Rocket that took part in the opening of the Liverpool and Manchester Railway. You say I give no proof of this. I say that I was on the spot, knew the engine thoroughly well, and frequently rode on her both before and after the opening, and know for a fact that it was the same engine and no other. If such evidence is not good enough, I don't know what is. I take it that the evidence of an eye-witness of any event is generally held to be more valuable than that of people who were not near the place and who have no knowledge of it, except what they have heard from others, and also more valuable than any number of sketches made years afterwards. Mr. Nasmyth and Mr. Stenson may both have sketched a Rocket, but they may rest assured it was not the Rocket built in 1829 which won the Rainhill trial and afterwards took part in the opening of the Liverpool and Manchester Railway after working on the line during its construction.

Howden, January 14th. ROB. STANNARD.

[Neither Mr. Nasmyth nor Mr. Stenson asserts that he has sketched the Rocket of 1829, although it is very possible that Mr. Nasmyth at the time took it for granted that the Rocket which he sketched was the 1829 engine. Are we to understand Mr. Stannard to say that there never was in 1829 or 1830, any Rocket but the one on the Liverpool and Manchester Railway?—ED. E.]

SIR,—You need not expect any further communication from Mr. Boulton, of Ashton-under-Lyne, in reference to Rocket. Your finishing paragraph after Mr. Stannard's letter this week is enough to convince any one you are determined to have your own way. Your false statements will be shown up in another quarter.

W. JEFFERY.

6, Plymouth-view, Manchester, January 12th.

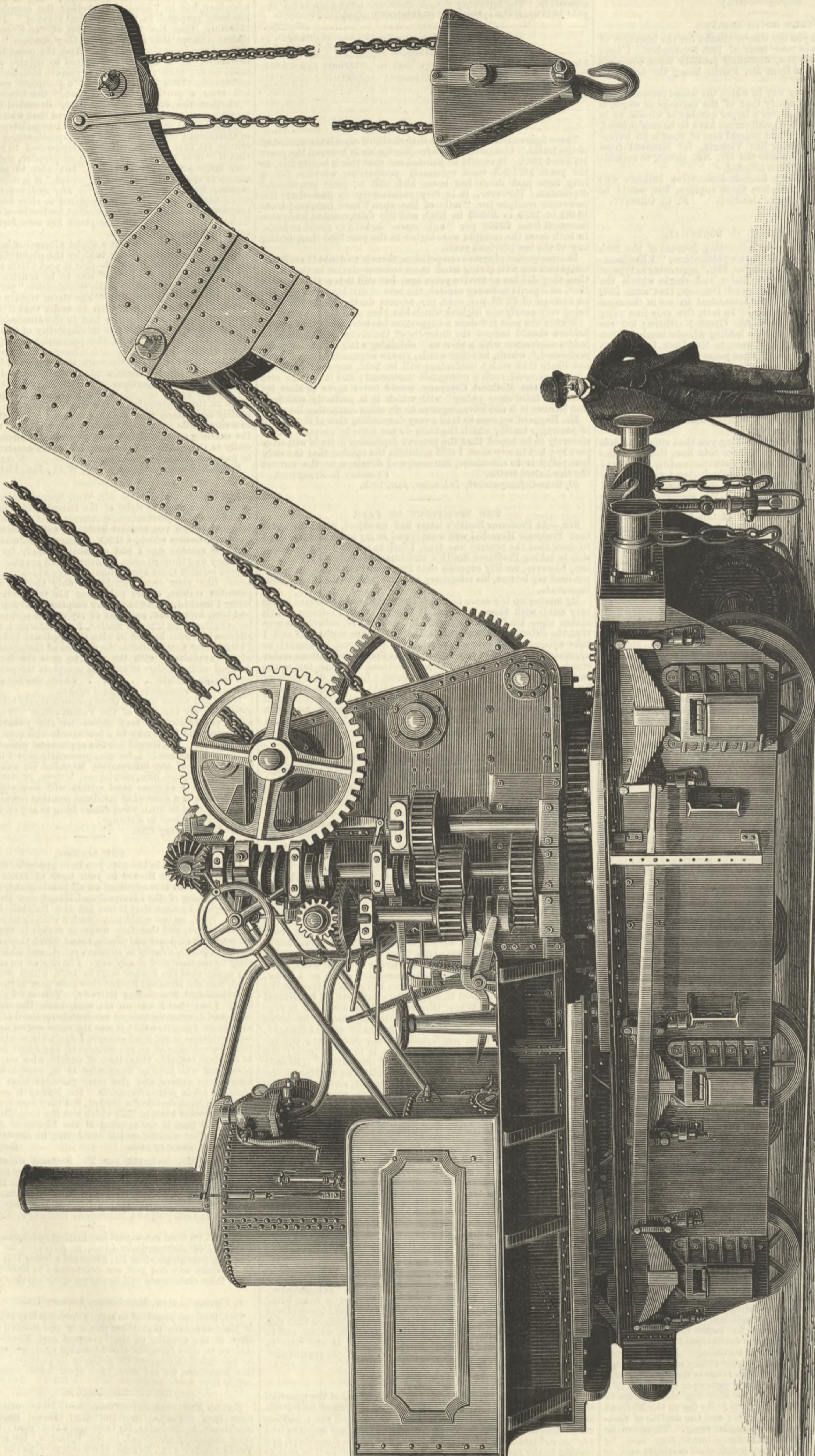
[Mr. Boulton promised to supply documentary evidence in favour of his contention that there was only one Rocket existing at the time of the opening of the Liverpool and Manchester Railway. Are we to infer from the above that his views are changed, or that he has failed to discover the evidence he promised? Our readers, like ourselves, we are sure, have open minds upon this question. —ED. E.]

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—David Robb, inspector of machinery, to the Indus, for Devonport Dockyard; William Castle, chief engineer, additional, to the Hibernia, for service at Malta Yard; Gustov A. C. Bencke, chief engineer, to the Flora, for Cape of Good Hope Yard; George A. Haddy, engineer, to the Indus, for service in the Penguin.

LOCOMOTIVE BREAKDOWN STEAM CRANE—TAFF VALE RAILWAY.

MESSRS. ALEX. CHAPLIN AND CO., GLASGOW AND LONDON, ENGINEERS.

(For description see page 42.)



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T. J. M. (Windsor).—*We fail to see any special novelty in your invention, and we fear that the rods are too delicate and too near the ground to stand hard work.*

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M. C. S. (Liverpool).—*Open the blow through cocks and turn steam into the condenser; open the cylinder drain cocks; open the steam stop valve, and give at the same time a little injection by opening the injector cocks; then, as the engines acquire speed, give more and more steam and injection until the proper speed and vacuum have been obtained. To stop the engines reverse the process, shutting the injection off first.*

LLOYD'S PATENT WELDING PROCESS.

(*To the Editor of The Engineer.*)

SIR,—Will any reader kindly give me any information he can about Lloyd's patent welding process—date of patent and number?

Ilkley, January 8th. J. B. G.

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, Jan. 20th, at 8 p.m.: Ordinary meeting. Paper to be read with a view to discussion, "A Comparison of British and Metric Measures for Engineering Purposes," by Mr. A. Hamilton-Smythe, B.A., M. Inst. C.E.

ROYAL METEOROLOGICAL SOCIETY.—Wednesday, Jan. 21st, at 7 p.m: At the annual general meeting the report of the Council will be read, the election of officers and Council for the ensuing year will take place, and the President will deliver his address.

SOCIETY OF ARTS.—Monday, Jan. 19th, at 8 p.m.: Cantor Lectures. "Climate, and its Relation to Health," by Mr. G. V. Poore, M.D. Lecture II.—The effects of soil, drainage, and vegetation upon climates. Wednesday, Jan. 21st, at 8 p.m.: Seventh ordinary meeting. "Labour and Wages in the United States," by Mr. D. Pidgeon. The Hon. James Russell Lowell, the American Minister, will preside. Thursday, Jan 22nd, at 8 p.m.: Howard Lectures. "The Conversion of Heat into Useful Work," by Mr. W. Anderson, M Inst. C.E Lecture IV.—The working substances in heat engines—gunpowder gases coal gas—hot air—steam—the method and cost of preparing the working substances—the theoretical calorific power of fuels, the degree of efficiency to be expected, and the efficiency actually realised. Friday, Jan. 23rd, at 8 p.m.: Indian Section. "The Agricultural Resources of India," by Mr. E. C. Buck, Secretary of the Government of India in Revenue and Agricultural Department. Sir James Caird, K.C B., LL.D., F.R S., will preside.

THE ENGINEER.

JANUARY 16, 1885.

THE WATER SUPPLY OF LONDON.

NOVELTY has not always marked the schemes for the supply of water to London. The last new scheme does not pretend to novelty in principle but it does in application. Mr. J. Thornhill Harrison has departed from the lines of any of his predecessors in the attempt to deal with London water requirements. His report to the Local Government Board, which embodies his scheme, was referred to in our last impression; but London is so much larger than any other city that we may be permitted again to say something on its water supply as dealt with in this report. There is much in the scheme to recommend it, and if ever the abstraction of water direct from the Thames for London potable uses is discontinued, this scheme will perhaps recommend itself more strongly than most of those which have come before the public, for it promises, as it stands on paper, to be the cheapest. This, unfortunately, is its chief recommendation. What is Mr. Harrison's proposal? Briefly this. He finds that the quantity of water which found its way into the Thames between Maidenhead and Teddington last July by means other than by tributaries—that is to say, by spring water flowing from the chalk and gravel—was 116 millions of gallons per day. He proposes to intercept the flow of a large part of this into the river, by means of a collecting tunnel at a sufficient depth below the surface to intercept the springs and fissures. Instead, then, of the companies taking their water out of the river to the extent of about 80 millions of gallons per day, he proposes to make an artificial underground river in the locality of that part of the Thames that lies between Bray and Black Pots, the latter place being a little south of Slough and a little north of Windsor. This collecting tunnel would begin near the river opposite Bray, and depart somewhat from it in a slightly curved line, nearing the river again at Black Pots. Here would be a big well and overflow weir, whence the water would be carried to the London companies' intake in a brickwork tunnel twelve miles in length. The proposition, then, comes to this. Instead of taking this spring or chalk water out of the Thames, we are to take as much of it as we can get out of a five mile collecting tunnel, before it goes into the Thames. This tunnel is proposed to be made in the chalk, and to vary in size from 4ft. diameter near Bray, to 12ft. at Black Pots. It would be five miles in length. Along the line of the collecting tunnel it is proposed that wells should be made, or it is admitted that these might be wanted.

The whole gain then resolves itself into one of supposed superiority of the water so obtained. The present cost of filtration, and the £11,000 per year paid to the Thames Conservancy, making together £19,400 per annum, would be saved, but at the expense of a capital outlay of at least £700,000. Assuming, however, that the difference in the character of the water so obtained was worth the interest on £700,000, less, say, £20,000, the first question is, What probability is there that 80,000,000 gallons of water per day, or anything like that number of gallons, are likely to be obtained from a collecting tunnel, five miles in length, in the chalk, supplemented by a few wells a little north of it, and connected with it by headings? Chalk may be looked upon as a splendid water reservoir, but it has been shown over and over again that after the surcharge is given up and the fissures emptied it gives up its contents very slowly. It is not necessarily an objection to a scheme that it has no precedent, but it is a fact, which causes some difficulty in considering Mr. Harrison's proposal, that we have really very little experience of extensive chalk supplies, and the experience gained at many rather large wells is hardly encouraging enough to make prophecy as to the yield of a long tunnel much more than sheer guess.

The largest example of water supply by long collecting tunnels, or one of the largest, is at Brighton. Here every feature is in favour of the catchment by the tunnels of a large and splendid supply. Innumerable fissures in the chalk, running more or less normal to the sea, and not intercepted by withdrawals for the supply of any neighbouring towns, are made to give up their water to the collecting tunnels made by Mr. Easton. These tunnels are altogether about a mile in length, including a recent extension of about 600ft., and at present collect about five millions of gallons per day. The water-bearing fissures are seldom more than 30ft. apart, and the conditions, as far as a chalk supply is concerned, are certainly as good as along the line of the proposed London scheme. If, then, the Brighton collecting tunnel yield is to be any guide, the Bray-Black Pots tunnel will give about twenty-five millions of gallons per day. The Brighton yield may be taken as a little over a million gallons per 1000ft. in length. What reasons are there for expecting more than this from the tunnel proposed by Mr. Harrison? Perhaps it may be expected that as the tunnel is proposed to be about 16ft. below the summer level of the Thames, that the Reading beds overlying the chalk in the district may add materially to the flow in the fissures. It is not, however, clear from the report what is expected, for Mr. Harrison admits that the design of the tunnel "would of course be modified very considerably should a more definite scheme be prepared," and there is very little evidence given as to the probable quantity of water that would be obtained, except by inference that as 116 million gallons of spring water find their way into the river, an intercepting tunnel would probably trap a lot of it. This is exactly what is very uncertain, and until a good many borings are made it is not possible even to make a good guess estimate of what quantity of water five miles of tunnel in this district would yield, and hardly then.

Fears have already been expressed that this abstraction of a very large quantity of water on its way to the Thames will have a serious effect on the dry-weather condition of the river. It does not, however, appear that any fears need be entertained on this head, for even if the tunnel afforded the 80 millions of gallons now taken from the river by the companies, it would make no difference to the river, for it obviously cannot affect its level whether 80 million gallons are pumped out of it as fast as they run in, or whether they do not run in at all. Fears might, however, reasonably be entertained that the Bray end of the tunnel, where it is very near the river, might become a drain on that section of the river, and its *régime* might be thus seriously affected. The fissures which are relied upon to give a good deal of the supply might turn up just here and lead direct from river to tunnel, or in fact the fissures might anywhere along the length of the tunnel simply connect it with the river. The proximity of the Bray end of the tunnel to the river would also make the insertion of say a three-feet pipe, connecting river and tunnel, very easy, so that if the chalk tunnel showed itself incompetent to give the required supply there would be great temptation to get it direct. This question is of course one which needs careful consideration, but the grounds for fears on this head are not very numerous. Mr. Harrison's scheme is, however, one which deserves consideration, for it is simple, affects few rights, mars no property, and is not supposed to cost so much as most other proposals—that is, if five miles of gathering tunnels would be enough. What it would cost if fifteen or twenty miles of such tunnel turned out to be necessary cannot be stated, but in that, or in any case, Londoners might be sorry they had not stuck to the river, after having spent so much money and legislation on its purification.

We may here recur to one question relating to the London water supply. We may ask the question, What is the proportion of the water supplied to London per day which is absolutely wasted—that is, not used in any way, but is lost by broken underground mains and pipes, and by bad fittings of all kinds? We may answer the question, and say at least one-third. With a proper system of waste detection and inspection, one of the chief difficulties of the future supply might be got over, for the demand on river or wells would be reduced to an extent not generally thought likely. Mr. Lass's excellent analysis of the accounts of the water companies for the last financial year gives the number of houses supplied as 654,102, and the number of gallons per head of the population per day as from 26 to 38 gallons per day, or an average of 30·3 gallons. Taking the purely domestic supply as using 80 per cent. of the whole 145 millions of gallons supplied, the average per head is reduced to 24·25 gallons. A better idea of how high this is may be gathered from the fact that the average daily supply is 181 gallons per house, and some very little things are called houses.

THE VIRTUE OF WEIGHT.

A DESIGNER need never be at a loss for information concerning the dimensions which ought to be imparted to the various members of a machine in order that they may be strong enough to resist the known or calculable strains to which they will be submitted. Text-books dealing with the strength of materials, and teaching the student how to calculate stresses, exist by the dozen; but all the information which can be obtained in this way is quite powerless to enable a man to design, let us say, a steam engine which will give satisfaction to its owner, simply because no text-book either does or can deal with certain conditions continuously varying and continuously met with in practice. To combat this difficulty experience and judgment can alone be employed; and the great difference between the merits of different engineers as designers lies more in their judgment—which is a form of brain-power—and experience than in perhaps anything else. Tables of dimensions of various parts of engines have been prepared, and may be used as guides, but only as guides. They are, however, in many respects more satisfactory than formulæ; but this is true perhaps only because the available formulæ are not quite what they ought to be. Much of what we are about to say applies to all machinery, but we shall for convenience deal with but one, the steam engine.

Every steam engine requires to have what is, in one sense, redundant structure—in a word, mere weight or massiveness, in order that it may perform properly. The greater the skill of the designer the smaller will be the amount of redundancy required; but, as a rule, a display of such skill is only required under very special circumstances. For example, engines intended to propel torpedo boats must be as light as possible; and the greatest care must be taken not only to proportion the various parts so that they may be quite strong enough without being too strong, but to direct the lines of stress in such a way that the maximum degree of stiffness may be obtained. It may be laid down as a fundamental principle, that that steam engine is the best which is most rigid and most free from vibration, and the simplest possible way to obtain rigidity is to use plenty of metal. No doubt the result of going on this system is to offend against the precepts of many text-books, and to incur some expense; but in the long run the heavy engine will be found better than the light engine, always provided that weight is not wasted, but is put in the proper place. Let us take, for example, an engine of a very common type. It has a bed consisting of rectangular frames. On one of these frames is cast a plummer block; both frames carry guide bars for the piston-rod crosshead. The cylinder is bolted on to the top edges of the side frames or girders. One end of the crank shaft is carried by the engine frame, the other in a wall box. We shall suppose that the engine is of good size, say with a 30in. cylinder and a stroke of 5ft., and that it works with a pressure of 70 lb., the steam being cut off early in the stroke. The centre line of the cylinder will be 15in. or so above the tops of the girder frames, so will be the centre line of the crank shaft. The gross load on the piston at the beginning of each stroke will be $70 \times 708 = 49,560$ lb., or, in round numbers, 22 tons. The distance between the centre of the length of the cylinder and the crank shaft bearing in such an engine may be taken as 20ft. We have, then, a girder 20ft. long, with a bending effort of 22 tons, operating on a lever 15in. long, brought to bear on it at every stroke of the engine; and beyond all question such a girder will bend, no matter how deep and heavy it is, the question how much it will bend being determined by the depth and mass of the girder. Engines of this type may be seen in which the rocking motion of the cylinder is quite apparent to the eye, and is sometimes so considerable that it is not easy to keep the joint of the steam pipe with the valve chest unbroken and tight. It is quite beyond doubt that the bed-plate is in these cases quite strong enough to withstand the strains to which it is submitted, but it is not stiff enough to make the engine satisfactory. Again, let us take the case of crank shafts, especially those which are bent out of the round or slabbed and slotted out. There is no defect more common than to find such cranks "whip" at each stroke of the engine. They are by every possible rule amply strong, and they are of excellent material. Tested by the text-books, their only fault is that they are much too strong; but they have the great defect that they lack stiffness. It will perhaps be asked here, What then? Suppose that a cylinder has a rocking motion, and that a crank shaft whips, what harm is done? As to the first point, the wear and tear of guide slides and bars and stuffing-box packing will soon give an answer, to say nothing of the certainty that sooner or later the bed-plate will break. It is only a matter of so many millions of bendings. As to the bending of the crank shaft, the answer is that hot bearings will be the rule instead of the exception; and that it will be almost impossible to keep any brasses tight. The engine will "knock," and the use of lubricants must be extravagant. Material is wanted, not in order to secure strength, but to obtain stiffness, and so to get rid of deflections, tremours, and vibrations which are all more or less inimical to the good working of the machine, and likely to shorten its life. A well-designed engine with plenty of material in it will be found at work half a century after a light machine of the same power has gone to the scrap heap.

We are quite prepared to hear it objected that the proper way to obtain this much-desired stiffness is not to put in dead weight, but to dispose the metal to take all the strains under favourable conditions. Now in reply, we may say in the first place, that we are not prepared to deny that there is much truth in the argument; but in the second place, it must not be forgotten that mere dead weight or mass is in many cases essentially necessary to take up vibration. If, for example, we have a bridge carrying the footstep for the vertical shaft of a heavy spur or bevel wheel, it will be found that such a bridge if made just of the proper dimensions to carry the weight of the wheel will be useless for its intended purpose. It must be made very much bigger and heavier, for no other purpose than to resist vibration and tremour. It must be stiff as well as strong. But leaving this aspect of the matter, it may be shown that it is not quite so easy a thing as it appears at first sight to be, to dispose the parts of a steam engine in such a way that all motion of these parts will be averted. Of course the idea is that each stress shall be made to pass directly through a mass of metal, and not outside it. Thus, for example, the cylinder of the engine referred to above might be dropped down between the two girders. The crank might be made in the middle of the length of the shaft, and this last might have a bearing in each girder. The line of stress running through the centre of gravity, let us say, of the girder in this case the cylinder could not move; and there can be no doubt but that less material would give a stiffer, and so far a better engine; but then where is the valve chest to be placed? and how are the guide bars to be attached? the Corliss frame has been specially designed to give stiffness with a minimum quantity of material, and it does this successfully; but the Corliss frame was never designed by the aid of text-books. To cure the whipping of crank shafts, which is especially manifest in double-cylinder engines, a third bearing may be put in, and is being used now by many builders of electric light engines; but there is much to be said against the use of this bearing. It is very difficult indeed to keep three sets of frames all in a line unless the frames are very stiff, which they seldom are; and there is reason to believe that a better result would be got by putting the cylinders close to the frames with the valve chests inside, just as is done in locomotives, and keeping the crank shaft very short by making the bed of the engine narrow, and using a heavy crank shaft. Few land engines—out of railway works—have double crank shafts nearly as stiff in proportion as those used in locomotives. Here, again, mere strength has nothing to do with the matter—quantity of material is used to impart stiffness.

It is not to be assumed, as a matter of course, that the mere putting in of ties and struts, so to speak, at the proper place will ensure freedom from motion of parts. A remarkable instance of the truth of this statement is supplied by tandem marine engines. The high-pressure cylinder is frequently carried on three stout wrought iron legs bolted to it, and to the cover, strengthened for the purpose, of the intermediate cylinder. Now it would appear that the strains must operate so directly through these three legs in the way of push-and-pull that no possible rocking of the high-pressure cylinders could take place. As a matter of fact, however, they do rock; and it is even found difficult to keep them perfectly in line with the cylinders just below them throughout the stroke; and this is one of the reasons why the tandem system is not much favoured now at sea. Furthermore, the putting in of ties to stiffen structures intended to be heated is not invariably satisfactory. Thus, for example, we have known instances in which heavy wrought iron ties were put in to couple a plummer block with a cylinder, and so to prevent rocking, with the result that the cylinder flanges were carried away. A remarkable example of this was reported in our pages some years ago. The engines of the twin ship Calais-Douvres broke down from this cause, the cylinder covers being split. So far as could be seen, the design of the engines seemed to be very good; but practically they were defective. We may conclude this article by mentioning a case, the particulars of which are, no doubt, well known to not a few of our readers, in which a pair of compound engines running at a rather high speed were put into a mill to take the place of a pair of heavy old-fashioned engines of the side lever type. The new engines were absolute failures, and the mill had to be driven again by the old engines, which had been disused but not taken down. We have been unable to do more than touch the fringe of a very important subject. If, however, we have succeeded in setting some of our younger readers thinking, our purpose will have been fulfilled. There is much more virtue in a lump of cast iron properly disposed than appears at first sight.

VALUE OF VESSELS.

DURING the past year one of the most marked commercial changes has been in the value of steamships. It is not only the market value, for that is a fluctuating one which we cannot much notice, but it is in the value as estimated by the earning power, and by the declaration for insurance. It would seem that we are on the point of changes in regard to ships which will very seriously alter their comparative earning power, and which have in consequence very greatly altered their value. Already shareholders in and owners of steamships are making up their minds as to the value at which these shall be insured for the next insurance year, and in most cases there is a fall in the sum when compared with that of the insurance year that is now all but expiring. The question of the assessment of that value is growing much more difficult. There is a loss of vessels yearly, and whilst on the one hand the owners ought not to suffer much in the case of the loss of the ship, yet on the other hand the cost of insurance is so great that the declared value needs to be kept as low as possible to limit the sums paid as premium or in the shape of calls. When in one year the value of a vessel may fall 10 per cent., as is said to be the case very often in the present year, and when it may be fairly believed that there will be an early recovery in the earning power of steamships, and therefore in their real value, the settlement of the amount of insurance is a question of considerable difficulty. It is possible that it may have to be decided in some way other than the stating of a value that is to remain fixed during the whole of the year, whilst the real value rises or falls very considerably in that time. Whether the settlement should not be in the direction of giving the insurers the choice of payment or of replacement remains to be seen, but in some way the insured will have to deal with the question either by that or some equivalent which will prevent the loss of a vessel being either a gain through a fall in the value of the ship in the period of the policy, or a loss through a rise in that value in the same time.

IRON AND STEEL RAILS.

IN the copious reviews of the trade of the country, very little notice has been taken of the fact that there has been a further progress in the decay of the iron rail manufacture. A detailed statement of the exports of iron rails showed that whilst in the year 1883 we shipped 24,306 tons of iron rails only, in the past year that small tonnage further fell to 15,581 tons, and there seems ground for the belief that it is further falling, and that the iron rail manufacture is practically extinct. It is also noticeable that the small quantity that has been sent away was declared at prices above those of steel rails, so that it may be assumed that there was simply the export of special qualities or sections for some particular work in the Argentine Republic—to which one-half of the total was sent—the East Indies, and a few other countries. In the steel rail trade there was a large decline in the year. In 1883 our exports of steel rails were 754,108 tons, whilst for the year 1884 the exports fell to 526,169 tons. For the last year Australia was our largest customer, but both it and the East Indies showed a fall in the amount of their purchases from the quantity in the preceding year. Russia and Sweden increased their purchases last year, but there was a serious falling off in the tonnage sent to Italy. It is to be hoped that we shall find an increase in the quantity to be sent out this year; but if so, it is scarcely to be expected that the increase will be in the exports to the United States, though there should be more hope of the shipments to the Indies and to the East generally. More and more for years steel has been taking the place of iron both for rails and for other purposes, and it is by no means impossible that the present year may witness the extinction of what was once a very great support of the iron trade—the iron rail manufacture, because the latter is now supplanted by steel.

THE RATING OF COAL COMPANIES.

SOMETIME ago the Sheffield Coal Company appealed against the rate imposed by the Assessment Committee of the Sheffield Union and the Overseers of Handsworth. Their coal mines in the parish of Handsworth had been assessed by the Assessment Committee at £5336 5s. gross, and £4033 6s. 3d. as the net rateable value. The Assessment Committee arrived at these figures by taking the coal as being worth £200 an acre, and the calculations were based upon the rentals actually paid by the appellants. The Colliery Company admitted that their actual rents were as high as £200 an acre, and in some instances even as high as £300 an acre, yet that these rents were in themselves no absolute criterion as to the value. They further contended that these rents were agreed to be paid at a time when their local trade, or when the general circumstances of trade, were entirely different to what they are at the present time, and that no person now taking to the mines at a reasonable lease could afford to pay more than from £100 to £150 per acre. The appeal was to have been heard at the Sheffield Sessions last Friday, but an agreement was come to after a conference between the Company and the Committee. The result of the conference was that the assessment was reduced from £5336 5s. gross to £4050 gross, and from £4033 6s. 3d. net rateable value to £3037 10s. net rateable value, accepting for the purpose of this reduced assessment the gross estimated rental of £150 per acre. This settlement has a most important bearing on the rating of collieries in this district as well as generally, for it decides the great point that the colliery owners are entitled to have their property assessed at the present commercial value of the coal, although the rent actually paid may be in excess of that value.

LITERATURE.

The Alkali Makers' Pocket-book. By GEORGE LUNGE and FERDINAND HURTER. 8vo. pp. 168. London: George Bell and Sons. 1884.

THE want of uniformity in analytical methods and matter required for calculating the results of analyses has led to great difficulties in the purchase and sale of materials, as well as in the control of the different operations in chemical manufacturing on the great scale. In order to remedy this defect a committee of seven members was appointed to draw up a standard manual, the compilation of which was entrusted to Dr. Lunge, professor of technical chemistry at Zurich. A primary condition required was that only a single method should be adopted for each operation, whether analytical, the preparation of standard solution, or sampling, in order to eliminate discrepancies arising from differences of method. The selection of one out of many methods was necessarily a work of considerable trouble, as in many cases doubtful points had to be cleared up by experimental researches occupying a long time. Where several methods of equal accuracy were in use, the preference was given either to the most expeditious, that requiring the least apparatus, or that most widely known and employed. At the same time tables of specific gravities of solutions and other useful physical constants were collated, and where necessary new ones were computed. The MS. when completed was subjected to the criticism of the full committee, and when agreed to it was published, the small compass of the volume giving but little indication of the labour expended on its preparation. The first seventy pages are devoted to tables of physical and chemical constants, factors for the computation of analyses, &c. &c.; while the second, or special part, gives details of the analytical methods employed, classified under the heads of the different manufactures to which they belong, namely, sulphuric acid, salt cake and hydrochloric acid, bleaching powder and chlorate of potash, soda ash, nitric acid, potash and ammonia. An appendix contains some useful rules for sampling. The English edition is due to Dr. Hurter, who has made several additions, including a section on chimney gas testing, giving the rules required by the Alkali Works Regulation Act of 1881, and has also recomputed most of the tables for English weights and measures. There is so much information of value contained in the volume that it will be a useful addition to the working library of chemists and engineers even when they are not directly connected with the alkali trade. In a future edition it would be well to revise, or even omit, Table 33, which professes to give the exact value of the coinage of foreign countries without stating the measure of value adopted. The statement that the weights and measures of the United States are the same as in Great Britain also requires qualification, as the former country does not recognise our principal measure of capacity, the imperial gallon, preferring the older wine gallon used before the adoption of the imperial standard.

BOOKS RECEIVED.

La Navigazione Elletrica, Salvatore Rainera. Roma: Ermanuo Loexber. 1885.

The Compendious Calculator. By Daniel O'Gorman and J. R. Young. Weale's Series. London: Lockwood and Co. 1885.

Traite d'Exploitation Chemins des fer. Par A. Flamoche et A. Huberti. Tome premier. Route, Voie, Appareil de la Voie. Bruxelles: G. Mayolez. 1885.

The Works' Managers' Hand-book of Modern Rules, Tables, and Data. By Walter S. Hutton. London: Crosby Lockwood and Co. 1885.

The Boiler-makers' Ready Reckoner, with Examples of Practical Geometr yand Templating. By J. Courtney and D. K. Clark. Second edition, revised. London: Crosby Lockwood and Co. 1885.

Mathieson's Vade Mecum for Investors for 1885. London: Mathieson and Low. 1884.

Sopra un Modo D'Interpretare I Fenomeni Elettrostatici Saggio Sulla Teoria del Potenziale. By G. B. Ermacora. Padova: A. Draghi. 1882.

The Wave of Translation in the Oceans of Water, Air, and Ether. By John Scott Russell, M.A., F.R.S. London: Trübner and Co. 1885.

Journal of the Iron and Steel Institute. No. 2. 1884. London E. and F. N. Spon.

Elementary Principles of Carpentry. By Thos. Tredgold, C.E. Sixth Edition. Revised and enlarged by E. W. Tarn, M.A. London: Crosby Lockwood and Co. 1885.

London and Provincial Water Supplies, with Latest Statistics of Metropolitan and Provincial Waterworks. By A. Silverthorne, Assoc. M.I.C.E. London: Lockwood and Co.

Transactions of the Sanitary Institute of Great Britain. 1883-4. *Vol. v. Congress at Glasgow.* London: E. Stanford. 1884.

Almanach fuer die K.K. Kriegs-Marine, 1885. Pola: Gerold and Co. 1885.

Transit Tables for 1885. *Computed for the Nautical Almanack for Popular Use.* By Latimer Clark, M.I.C.E. London: E. and F. N. Spon. 1885.

THOMAS JACKSON.

ON the 3rd inst. one of a remarkable type of able, self-dependent, leaders of men passed away. Thomas Jackson, of Eltham Park, Kent, died on the 3rd inst. He was one of the old railway contractors of the type of Brassey, Tredwell, and Wythes. He was born in 1808, commenced work at the early age of eight on the Birmingham Canal, with but very small advantages in the way of education, and toiled as a day labourer amid the greatest discouragements, till in 1827 he undertook a sub-contract on the canal then in formation near Market Drayton. Telford was pleased with Jackson's portion of the work, and the praise then bestowed was an incentive through life to the contractor to maintain his credit for good and trustworthy work. In 1837 his first railway contract was accepted for a part of the Birmingham and Derby Railway, near Wichnor; portions of the Chester and Crewe Railway were undertaken in 1840, and the Tame Valley Canal shortly afterwards. His next great work was the renovation of the Caledonian Canal, which, though now so well known as the tourist route to Inverness, had in 1843 become practically unnavigable, owing to dilapidations in the locks and want of depth. The Government hesitated as to renewal or abandonment. Messrs. Jackson and Bean undertook and successfully carried out the work of renewal at a sum considerably below that to which Mr. Walker, the Government engineer, had restricted the outlay. These operations were completed in 1847, and Mr. Jackson then returned to railway work—a large mileage of the lines in the Hull, Malton, and Beverley district being constructed by him. Works at Spurn Point, Shoreham, Luton, and Welwyn were undertaken; and in 1854 the construction of the large Tyne dock near Jarrow was in his hands. In 1847 he commenced the construction, under successive Admiralty engineers, of the gigantic breakwater at Alderney. The difficulties were unexampled, and for nearly twenty-five years a contest was waged against the whole force of the Atlantic; but the breakwater was at last completed. It extended a mile into the sea, and reached a depth three times that of the structures at Plymouth and Cherbourg. The fortifications for the defence of the harbour of Alderney, and the breakwater at St. Catherine's Bay, Jersey, were also successfully built by Mr. Jackson. His latest work was at Harrogate. Of sulphur, saline, and chalybeate springs Harrogate has an ample supply; but for pure water it is mainly indebted to the enterprise and engineering ability of Mr. Thomas Jackson. Of late years Mr. Jackson lived in comparative retirement, taking a close interest in meteorological and astronomical studies, as well as in scientific and geological questions. By his special desire he was buried at Audlem, the scene of his early labours on the Birmingham and Liverpool Canal.

FREE LECTURES TO ARTIZANS.—The Carpenters' Company announce a course of eight lectures to be given at their hall, London-wall, free to artizans and others connected with the building trade. The first will be delivered by Professor Kerr, of King's College, on Wednesday, February 11th, at eight o'clock, when the subject will be "The Comparative Anatomy of Beams, Trusses, and Arches." Tickets for the course can be obtained at the hall of the company after January 21st.

MINER'S SAFETY LAMPS.

AT a meeting of the members of the Manchester Geological Society, held on Friday last in the lecture hall of the Mining School at Wigan, the chair being occupied by Mr. W. S. Barratt, the president of the South-West Lancashire Coalowners' Association, the proceedings were entirely devoted to the discussion of questions connected with miners' safety lamps, and the chairman, in opening the meeting, said there was no subject in connection with mine engineering that was at present receiving or deserved more attention.

Mr. J. S. Burrows read a paper, in which he gave the results of experimental trials made with an automatic safety lamp, of which a description was given recently in our "Lancashire Notes," and he also added some notes on the various methods of locking safety lamps. In the course of his paper, Mr. Burrows said Mr. Martin, inspector of mines, the energetic honorary secretary of the society, had provided him for trial a lamp sent by Mr. C. E. Rhodes, and asked him to lay the results of such trial before the members. This he did with great pleasure, only regretting that he had not more information to give. The lamp might be briefly described as an ordinary Clanny lamp, fitted with an extinguisher, capable of closing, when down, the inlet and outlet air holes of the lamp, this again being enclosed by an outer shield, similar to that of the Marsant lamp. When in use the "extinguisher" was propped up by a piece of iron passing up through a hollow standard. The bottom of this piece of iron was formed into a kind of hook which rested on a piece of thread. The theory of this arrangement was that whenever the lamp was filled with gas the thread should burn, releasing the upright piece of iron or prop, and allowing the "extinguisher" to drop, thus cutting off all communication with the outside air, which of course would put out the light. It was needless to point out the advantages of being able to use a "Clanny" lamp when working, because it gave a good light, was much less liable to go out if tilted on one side than a Muesler, and if the extinguisher really did its duty in the presence of a dangerous quantity of gas, it was equally as safe, if not safer, than the best lamp known. Unfortunately, he was unable to say definitely from experience that the extinguisher did so come into play when the lamp was placed in a current of gas and air, as he had only been able to watch the behaviour of the lamp in out-of-the-way workings where gas could be found and where there was no current. The lamp was first tried with an ordinary gas jet on the surface, but the thread would not burn unless the lamp was so placed that the gas entered on the side where the thread was, but by so placing it the extinguisher was brought into play and the light put out. On trying the lamp underground in gas it went out just as any other lamp would do, but the thread was in no case burnt. In all the trials underground the gas was but little, if any, diluted with air, and it was his opinion that if the gas were sufficiently diluted with air so as to burn briskly inside the lamp, the thread would burn, and allow the extinguisher to come into action. With the view of testing whether the thread would break in ordinary use, when not required, the lamp was given to colliers and drawers instead of their own lamp. They were very pleased with the lamp after their own Muesler's, and the thread did not give way in a single instance. If, however, the lamp should prove to be so sensitive in a current of air and gas, it was an open question whether it was an unmixed benefit to be left in the dark when a lamp met with perhaps only a small quantity of gas, such as when a long wall face was "weighting," or when "prop drawing." Much attention had of late years been given to the question of safety lamps, but he had not noticed much said about the proper method of securing or locking the lamps when lighted, so as to prevent the flame being exposed either by accident or design. As this was a very important part of the question, he ventured to take that opportunity of bringing the subject forward. The devices for preventing the opening of safety lamps when at work were (1) the screw lock, when a short screw was tightened (*a*) against the threads on the lamp bottom, or (*b*) against the lamp bottom below the threads, or (*c*) from underneath through the lamp bottom and against the bottom ring of the lamp top; (2) a hasp attached to the lamp top passed over a projection on the bottom, and was secured by a common brass padlock and key; (3) the magnetic lock, as in the Wolff lamp, when the lamp bottom had to be placed over a powerful magnet before the ock bolt could be released to allow of the lamp being unscrewed; (4) the Protector Lamp and Lighting Company's patent, where on attempting to unscrew the lamp bottom the wick tube and flame had to pass through a collar held in its place by a simple arrangement with a spring, and which thus extinguished the light; there was a second locking arrangement with a lead rivet as well; (5) lead rivets, either (*a*) with the ordinary hasp, or (*b*) where two projections on the lamp top and bottom were brought opposite to one another and the rivet passed vertically through them. In either case the rivets were pressed between two dies, which marked each end of the rivet with some device or initials. With regard to screw locks they gave no security whatever. Any screw had always a tendency to slacken when there was any jolting or vibration. Again, if in locking, the end of the screw, instead of locking in its usual hole, was just on the edge, the first knock the lamp received in working probably caused the screw to slip off the edge into its proper place, when it was slack at once. Moreover, the head of the screw lock on which the key fitted wore away rapidly, and it soon became difficult to screw it up properly. Lastly, any one could open the lamp with a key, a nail, and even if the lock projected, with his teeth, and screw it up again in the same manner, the screw giving no indication that it had been tampered with. With regard to padlocks, they were of the commonest kind, and duplicate keys were easily obtainable. They also told no tales when they had been tampered with. He had never seen the magnetic lock in actual use, but he thought it was a satisfactory means of securing the lamp. The Protector Lamp Company's arrangement was certain to extinguish the light when the bottom was unscrewed, if the spring were pushed home and in its place, but a match would re-light the lamp, and were it not for the second lock with the lead rivet, would not show that it had been so treated. The lessening of the flame was effected by partially unscrewing the bottom, and in carrying the lamp the bottom has a trick of coming unscrewed until stopped by the second lock. The system of securing by lead rivets was not open to any of these objections. The rivets were stamped in the morning, before the lamps were given out, and remained just as they were unless the head was cut off. The person who defaced the rivet could not replace it unless he possessed a new rivet and a *facsimile* of the particular die in use, and the knowledge that when the lamp was handed in to the lamp room it would tell its own tale was sufficient to deter any one from meddling with it. At the lamp stations for re-lighting lamps underground, this locking, or rather stamping arrangement, was kept in a lock-up box, the key of which was in the possession of the jigger or other person appointed, and who was the only person allowed to relight the lamp. Of the two plans he preferred the one where the rivet was placed vertically through two projections on the top and bottom, as there was then sufficient play in the hasp to allow of the bottom dropping down in case the thread on the lamp bottom was much worn. This question of securing lamps was very important on two grounds,—First, it was no use having a perfect lamp in use if the light could be exposed by any one without much difficulty or fear of detection. Secondly, managers were exceedingly strict in enforcing the rules as to lamps, which was as it should be; but on the other hand they ought to be as particular in seeing that the means of securing the lamps were such as to leave no manner of doubt that they might, as he had tried to show with screw locks, come loose without any interference on the part of the workmen. Contracts to be binding must be mutual, and it was the duty of all concerned, whilst enforcing the rules to their utmost, to take care that it was not possible for an innocent workman to be sent to prison through having an antiquated and unreliable method of locking lamps. In conclusion, Mr. Burrows expressed the opinion that the question of lamps and locking would never be satisfactory so long as the men were made to find and clean their own lamps. He believed this bad system was dying out, but there were many places where it was still in force. A man who was required to find a Davy lamp at one colliery must perhaps find a Muesler if he moved to the next colliery, and possibly keep two or three other sorts if he wished to extend his movements, and it was only natural that he would buy the cheapest, and therefore the worst he could. Also he would put off renewing the gauzes as long as they would pass the foreman's cursory inspection when he went to work. Moreover, it was not easy to make change of lamps when the men had to find the money for a new lamp, in the choice of which they had no voice, and which might possibly be of no use if they left or were dismissed a fortnight afterwards.

Mr. Wm. Bingham, in proposing a vote of thanks to Mr. Burrows for his paper, said the subject was one of very great importance, and they were very much indebted to Mr. Burrows for the manner in which he had brought it forward.

Mr. Tonge, in seconding the proposition, said he fully agreed with what Mr. Burrows had said that the best system which could be adopted with regard to lamps, irrespective of any particular form or design or manner of locking, was that all the lamps should be found by the colliery proprietor; when they had to be found by the men, it led to very defective lamps being used.

The vote of thanks having been unanimously passed, the chairman expressed the opinion that it was very essential that subjects such as had been dealt with in the paper should be brought before a society like that.

Mr. Budenberg, of Manchester, also exhibited and explained the Wolf patent safety lamp—of which a description has already been given in these columns—with the special arrangement for automatic re-lighting without opening the lamp, magnetic locking arrangement, and apparatus for charging and testing the lamps, which attracted a good deal of attention from the members present, and the testing apparatus was employed for trials with other lamps exhibited.

In the discussion which followed, Mr. Wm. Bryham expressed the opinion that it was not always advisable to give the men too ready a means of re-lighting their lamps should they have gone out in a highly explosive atmosphere.

The Chairman said he was sure the lamps which had been exhibited had been a source of great interest, and the Secretary informed him that a future opportunity of going further into the matter would be afforded, under probably more favourable conditions for testing the lamp than had been possible on that occasion.

Mr. Winstanley observed that the lamp shown by Mr. Burrows was no doubt a very ingenious arrangement, but it was a question how long a collier would be justified in remaining in an explosive atmosphere before the thread was burnt through; whether the collier would be justified in waiting until he was left in total darkness by the accumulation of sufficient ignited gas in the lamp to burn through the thread.

Mr. Burrows replied that one of the chief objects of the lamp was that under no circumstances could there be any mistake, whether the man was waiting, or whether in fright he ran away and left the lamp behind him. In either case it would be extinguished.

Mr. Martin, Inspector of Mines, said he had seen the lamp tested at the Aldwark Main Colliery in a velocity of 51ft. per second. The lamp remained burning for a few seconds, and was then extinguished. The extinguishing arrangement had nothing to do with how long a man should remain in his working place in an explosive atmosphere; there were rules which regulated that. The object was that in the case of a person unwittingly getting into an explosive atmosphere the lamp would extinguish itself. With regard to the question of locking lamps, they were all indebted to Mr. Burrows for bringing the matter forward. During the last few months the subject had come frequently under his notice, and he found numbers of lamps locked with a screw in the hands of colliers after they had worn quite loose. The question, therefore, was how far it was desirable to have a lamp of such a description placed in the hands of men subject to penalties for unlocking? The lock of the lamp itself had, no doubt, nothing to do with its actual safety. The object in the first instance was that the men should be unable to unlock it without being detected; secondly, that it should not be unlocked inadvertently; and thirdly, that it should not become unlocked without the action of the collier himself. Mr. Burrows had also made a remark that it was an unsatisfactory system which compelled the men to find their own lamps, and in this he agreed.

Mr W. Pickard, miners' agent, asked whether in such lamps as the Marsant and others, where a shield was introduced, this had not the effect of increasing the temperature of the lamp.

Mr. Burrows said that at their collieries they had 300 of such lamps in use, and the men raised no objections with regard to the heat. He had not found any higher temperature in lamps with the shield as compared with those without.

Mr. W. Pickard said that personally he had a strong objection to the shield, on the ground that it tended largely to increase the heat in the lamp.

Mr. Martin said that he had not in his experience, when carrying a lamp with a shield, found that it got exceptionally hot.

Mr. Pickard said this might not be the case in carrying a lamp, but it would be very different in a stopping place.

Mr. Hall, Inspector of Mines, in answer to a question, said that with regard to the point raised as to whether the lamps should be found by the mineowners or by the men, both systems were practised; but personally he thought there could be no doubt that there could be no better plan than that the owners should provide the lamps.

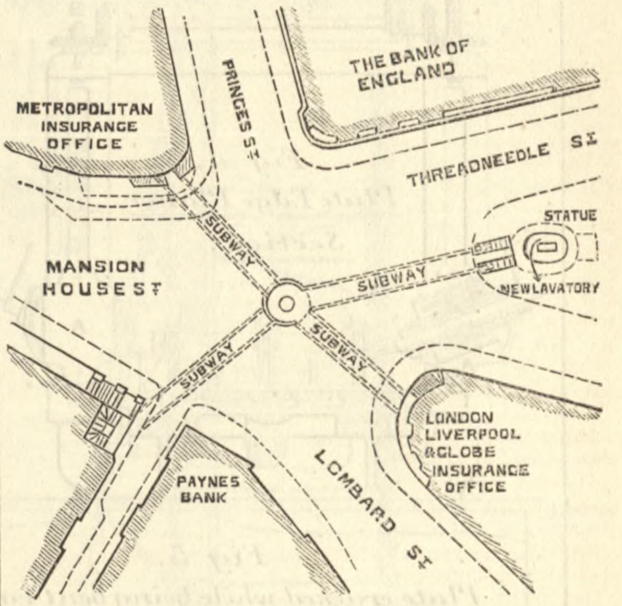
Mr. Pickard said he quite endorsed the remarks which had been made on this point. He should like to see the day when every colliery proprietor would feel it his duty to find all the lamps used in his mine. Many of the men had not the proper appliances for cleaning and preparing their lamps, and it was not right that a large body of men in a pit should be made liable to the possible indifference of one man. If every lamp was provided by the colliery, and handed to the men when they went down, properly cleaned and prepared, this would greatly conduce to the safe working of mines.

The Chairman said that, as a colliery owner, he entirely agreed with what Mr. Pickard had said. It was almost an obvious necessity that every colliery should find their own lamps. They then had a uniformity which could not be secured when men brought their own lamps, and there was no doubt that a considerable element of danger was introduced into a mine when men found their own lamps. At their own collieries they had provided the lamps for the men, and he thought they had been repaid in the knowledge of the greater security thus ensured. It also stood to reason that the colliery proprietor, in purchasing lamps for use in his mine, would get the best he could find, which could scarcely be said to be the case where a collier had to provide his own lamp.

The proceedings were then brought to a close.

MANSION HOUSE AND BANK SUBWAY.

ON Tuesday, at a meeting of the City Commission of Sewers Mr. H. H. Bridgman moved that on the completion of the purchase of the European Tavern and other properties opposite the Mansion House, it be referred to the Streets Committee to consider and report as to the necessity and practicability of constructing a subway across the street, to avoid the present danger of crossing and to facilitate the traffic in that locality. The scheme, of which he submitted a plan and map—from which the annexed engraving is taken—contemplated the erection in the centre of the roadway between the Mansion House and the Bank of a circular chamber about 20ft. in diameter, with an 8ft. skylight at the top. Around this he would place, on the surface, a pavement 6ft. wide, which would be an effective refuge for foot passengers who preferred to cross above ground. Under the surface the plan was to construct four radiating subways from the centre to the Union Bank at the corner of Prince's-street, to the north-east corner of the Mansion House, to the open space in front of the Royal Exchange, and to the Liverpool and London and Globe Insurance office at the corner of Lombard-street and Cornhill. Several objections had been and might be raised to the proposal, but none, he thought, were insuperable. As far as the gas and water pipes and the sewers were concerned the difficulty could be overcome, as it had been in other improvements. It had been surmised that the owners of property at the spot would offer objections, but the result of interviews he had had with them did not lead him to imagine that the objections, if any, would be serious. The Lord Mayor saw no diffi

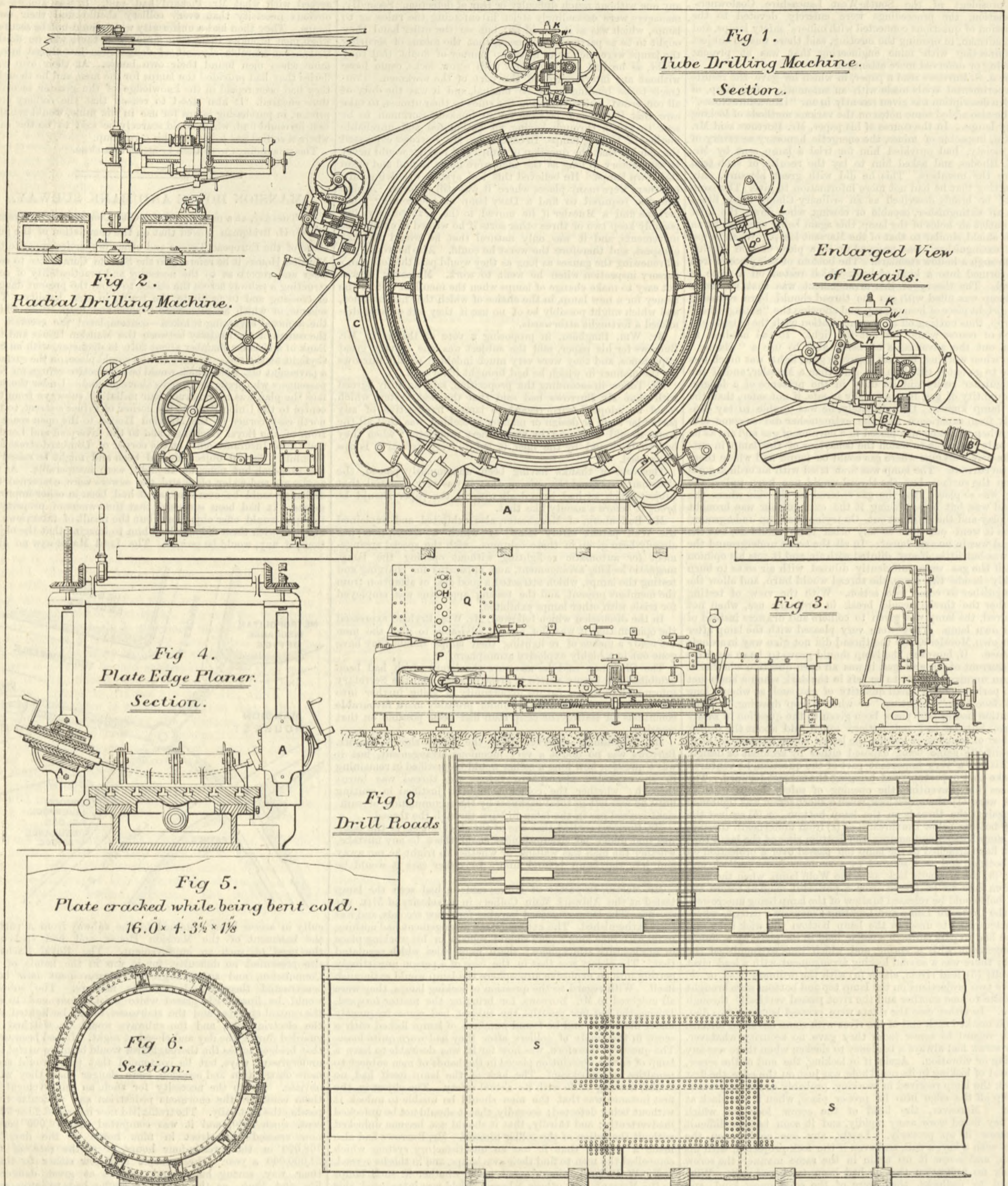


culty in access being obtained to the subway from a part of the basement of the Mansion House, and had spoken of the need of such an improvement. The Royal Exchange site presented no difficulty, for it was in the hands of the Commission, and an underground improvement now being constructed there would facilitate matters. The subways would be lined with glazed white bricks from end to end, the central chamber and the staircases would be lighted with the electric light, and the subways would be watched and guarded during the day and closed at night. It had been urged that bridges across the thoroughfares would be more useful than underground ways, but he contended that they would create more obstruction and occasion more danger than they would obviate. As to the necessity for such an improvement, let them consider the enormous pedestrian and vehicular traffic passing the spot daily. The traffic had now increased 29 or 30 per cent. since 1860, and it was computed that 70,000 persons now crossed the street in nine hours of the day, and 108,000 in the twenty-four hours, or at the rate of over 34,000,000 a year. These people had now either to thread their way among horses and vehicles at great danger to life and limb, or the vehicular traffic had to stop every few minutes to allow them to pass. In regard to the vehicular traffic it was stated that at that particular spot vehicles passed in sixteen different directions at the rate of 54,000 a day, or 17,000,000 a year; and it was still increasing. He—Mr. Bridgman—was quite aware of what the Corporation of London and that Commission had done within recent times to facilitate traffic. For instance, they had expended upon London Bridge £1,500,000; Blackfriars Bridge, £750,000; Southwark Bridge, £250,000; Holborn Viaduct, £1,750,000; Eastcheap, £300,000; and in other improvements over a million; but he contended that the plan proposed met a real need, and would afford a vast public improvement. After some discussion the motion was put and carried.

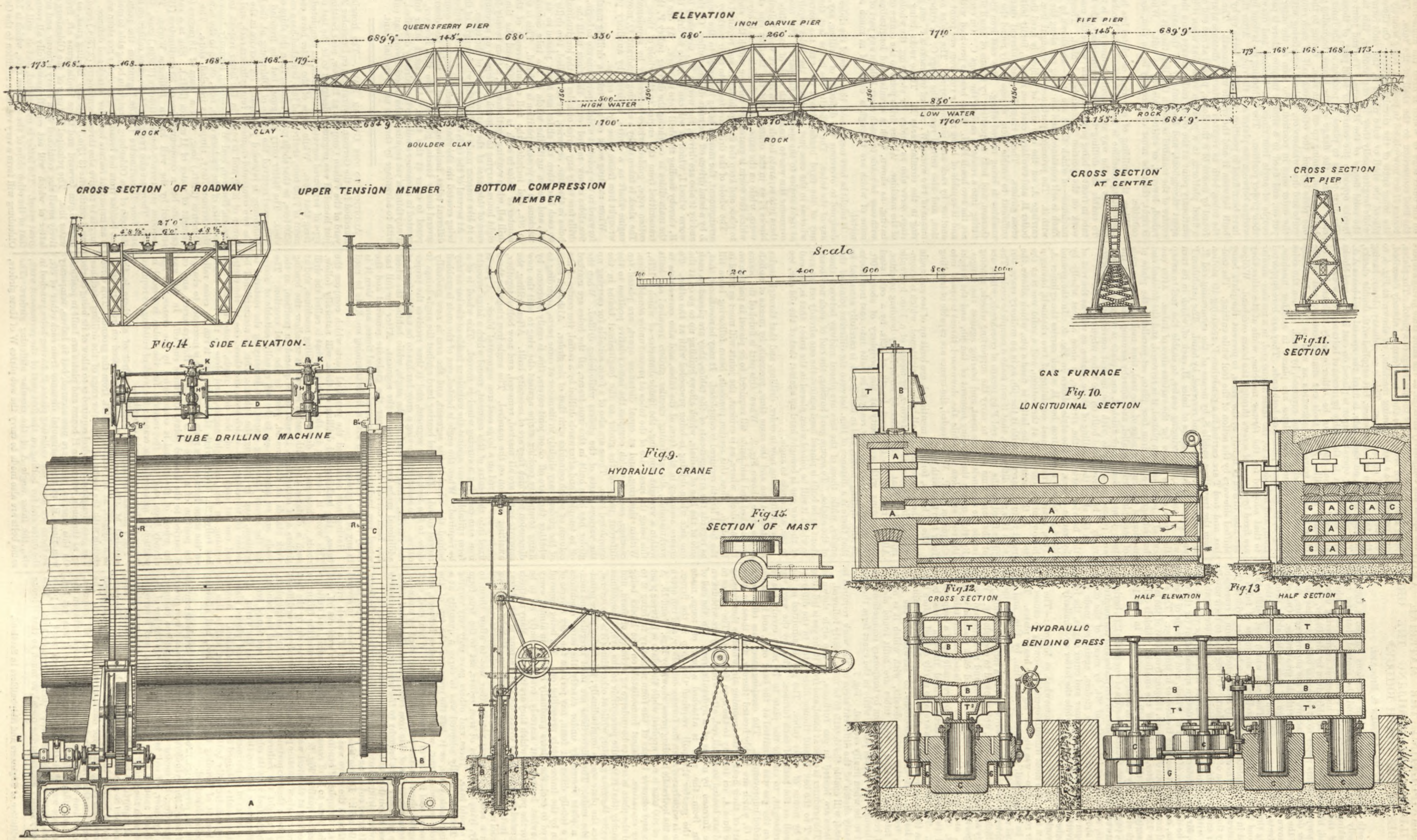
WHITWORTH SCHOLARSHIPS.—We are requested to state that the Lords of the Committee of Council on Education have caused a medal to be prepared by Mr. Allen Wyon, from designs by Mr. Poynter, R.A., as a memorial of the founding and endowment of the Whitworth Scholarships by Sir Joseph Whitworth. Their lordships have also authorised the issue of a copy of this medal to each of the scholars who have held scholarships, and have gone through the prescribed course satisfactorily. Scholars, or the legal representatives of such as are dead, are requested to inform the Secretary of the Science and Art Department at South Kensington of the address to which their medals should be forwarded.

MACHINERY USED IN CONSTRUCTING THE FORTH BRIDGE.

(For description see page 54.)



MACHINERY USED IN CONSTRUCTING THE FORTH BRIDGE.



ON MANIPULATING THE MATERIAL, AND BUILDING, AND DRILLING THE GREAT TUBES OF THE FORTH BRIDGE.*

By Mr. ANDREW S. BIGGART.

The Forth Bridge has on various occasions formed a theme of deservedly widespread interest, and the general character of the undertaking is more or less familiar to engineers. A comprehensive view of the subject, and of the numerous engineering questions involved, has also been lately so ably given by Mr. Baker, that the writer purposes in this paper to at once pass on to examine some of the later details of the manufacture of the superstructure, such as that of the work in connnection with the great tubes. One of the well-known features in the design of this undertaking demands that struts of hitherto unequalled length, and capabilities for resisting thrust, be employed. The form which best fulfils these conditions is the tubular. As well nigh six miles of tubes are required in the completed bridge, it at once becomes evident that the construction of them could only be effected within a reasonable time, by the adoption of special plant. Owing also to their novelty of form and great size, no machinery was in existence capable of dealing with such work. On account of this, and for various other reasons, Mr. Arrol determined to design special plant for the whole work, the description of a part of which, and the mode of working the same, can be but scantily treated of in this paper. The struts required are of various dimensions, ranging from that of the largest, which is 12ft. diameter, to that of the smallest, which is only 3ft. The description of the former will be considered in this paper, although all are very much alike in design.

Fig. 6, page 52, shows the cross section of one of the 12ft. horizontal tubes between the piers. It consists of ten plates and ten longitudinal H beams, stiffened at intervals of 8ft. by means of the circular girders shown in elevation. The girders, again, are made up of diaphragm plates, connected to inner and outer angles, the former being rivetted to the H beams, while the latter are similarly fixed to the tube plates.

The work to be performed is somewhat as follows:—The first, and, for a time, the most difficult operation—owing to causes to be hereafter referred to—was the curving of the heavy plates. These, it may be mentioned, are 16ft. by 4ft. 4in., by 1⅛in. and 1¼in. thick, and weight from about 28 cwt. to 32 cwt. each. The method now adopted is to bend them while hot in a large hydraulic press, from which they are removed, and allowed to cool slowly. When cold they are again placed in the press, and straightened finally. The edges and ends are then planed, and each plate is weighed, marked, and laid aside, ready to be placed on the tube when required. The longitudinal H beams are made up of a deep webbed tee and two angles, being partly drilled through these before erection. The circular girders are also partly drilled before being placed on the mandrel. These different parts form the main tube proper, leaving out the connections to skewbacks, the girder fixtures, tees, and other minor details, with which it is not at present intended to deal. The tubes are built round about a mandrel, being supported therefrom by temporary connections, and drilled through the various parts, while in the exact form they are intended to be when finally erected. Fig. 7.

This hasty sketch of the different steps of the work required to be executed, will enable the details to be more clearly followed.

The plates are heated in gas furnaces, of the style shown in Fig 10. The producer is close at hand, and from it the gas is led along the tube T to the box B, and thence distributed to the different furnaces by means of other tubes. The gas is admitted at the side as well as the back of each furnace. This, by the way, was an afterthought, to enable the plate to be more evenly heated than when the gas was admitted at the back only, and it turned out a decided improvement. The escaping gases pass off through the flues G, which are highly heated thereby, and these in turn give a part of their heat to the incoming air, which is then passing along the flues A, on its way to the open furnace. The plates to be curved are heated to a dull red, after which they are withdrawn from the furnace by means of a hydraulic ram. To the end of the chain from the ram is attached a pair of tongs, made so that the greater the pull required the grip is the firmer. The plate is withdrawn from the furnace on rollers, and run over a table into the hydraulic bending press, shown by Figs. 12 and 13. A pressure of 800 tons is now applied while the plate is between a set of convex and concave blocks of the form necessary to bring it to the proper curvature. Almost immediately on the blocks being separated the plate is seen to be undergo ng a change of form, and this so quickly that it is quite perceptible to the eye. Sometimes the convexity becomes greater, while at other times it is the reverse. In all cases the plate warps longitudinally, this taking place principally at the ends. The distortions are most irregular and inexplicable, a plate seemingly under exactly the same conditions assuming a totally different form, nay perhaps the very reverse of that taken by the immediately preceding one. On being removed and allowed to cool, the plates gradually become in almost every case somewhat better, but scarcely ever sufficiently so to be suitable for the purpose for which they are intended. Many methods were suggested, and tried, to overcome this warping of the plates: thus, for instance, the edges were covered up, thereby allowing them to cool more from the centre; another mode was to reheat and give them a second squeeze; yet another was to allow them to cool partly, lying on a series of iron rollers, set to the true form the plate should take. These and others gave only very varying success. The plan finally adopted was to curve a quantity at a time, laying each plate, as it left the press, on the top of the immediately preceding one, with a layer of ashes between, and allow them to cool in piles of convenient size. When cold, each plate is again placed in the press, and straightened by means of repeated squeezes, strips of thin iron being placed above and under the points necessary to be brought to the true form. This answers the purpose admirably, and is the only method now in vogue.

A somewhat striking incident happened during these preliminary trials. It arose out of an attempt to bend one of the 1⅛in. thick plates while cold. During this process the plate cracked in several places, although the curve was only equal to that of a circle with a 6ft. radius. Samples of bending and tensile tests were cut off, and showed the plate to be of remarkably good material, and quite up to the specified quality, Fig. 5. Mr. Arrol attributed the failure to unequal cooling at the steel works, and this is borne out by the fact that different parts of the same plate are not uniformly easy or difficult to cut, but both these experiences are often found in a single plate. Mr. Baker thought the failure of the plate to stand the bending was due to the fact that its edges and ends were not planed, but in the state they were in when they left the shears at the works. He had made a series of experiments with sheared and planed plates, and from the results obtained arrived at this conclusion. Annealing removes satisfactorily both these objections, and in this lies the great benefit of bending the plates while hot, and allowing them to cool as described.

The hydraulic press, Figs. 12 and 13, for bending the plates consists of a set of four 24in. cylinders C, resting on two cast iron girders G, and supporting, by means of two 7in. wrought iron columns, from each cylinder, a fixed table T overhead. On the top of the rams is placed another table T^2, which is raised and lowered in conjunction with the rams. Between these two tables are placed the blocks B required to bend the plates to their particular form, equal in this case to a curve, the radius of which is 6ft. The pressure brought to bear on the plates while being stamped is about 800 tons, provision being made for doubling this if necessary. The lower pressure has thus far been found sufficient for all purposes. After bending one of the first plates, it was kept between the upper and lower blocks for a few minutes while it was yet hot. The consequence was that the side of the block next the plate heated much more rapidly than the other, or remote side. This induced a very heavy strain on the metal, so much so that it broke the upper one completely through, at the same time giving a report somewhat resembling that of the discharge of a pistol. The plates, after having been brought to their true form, as already described, are passed on to a large planing machine, as shown at Fig. 4, to be there planed on both sides. This is an ordinary planer, having the table driven by a 6in. screw, but supplied with double cheeks, between which, on each side, is fixed the special tool-boxes A A. The plate being operated upon is placed on cast iron curved blocks and held down to the table by means of bolts and draw washers, arranged so that they can be either quickly tightened up or loosened at will. Both tools cut simultaneously, and as the plate is being travelled backwards as well as forwards. They are fed into their work, and reversed, by hand. When the sides have been planed, the plates are placed in another machine, Fig. 3, to be there planed on both ends. They are here supported from, and held down to, the table at one end, in a manner similar to that adopted for the former machine, while at the other they are fixed by means of screws through the beam overhead. Wedges are also driven in lightly at the sides, to prevent the plate being shifted sideways by the action of the tool while cutting. The tool-box and tool T are carried in a pendulum P, receiving its motion from the travelling saddle S, by means of the connecting rod R. Here also the tool is fed, and reversed, by hand. The pendulum P and plates Q have a series of holes H, each of which in its turn will be made a new swinging centre, to enable the tool to sweep the ends of the plates for the various sizes of tubes. After one end of a plate has been planed, it is reversed, and the finished end butted against a cast iron face plate, set parallel to the plane of motion of the cutting edge of the tool, thus making the two ends of each plate truly parallel, and thereby securing accuracy at the tube joints. Being now finished, each plate is weighed, marked, and placed on the pile with the nearest corresponding weight, ready to be removed and built on the tubes when required.

In the shops the handling of these plates, as well as the rest of the heavier parts of the structure, is done almost wholly by hydraulic cranes, of the style shown in Fig. 9. In the ground there is placed a cast iron box B, which carries the cylinder A. This, again, carries a mast consisting of two channels, having a hollow turned casting H at the bottom, and a solid one S at the top. In the centre of the latter is fixed a pin, which allows the mast to turn, carrying with it the jib, as in an ordinary crane, but with this great difference, that it can make a complete circle. The jib is fixed to the piston rod P by means of crossheads, which are at the same time made to carry the supporting wheels, running inside the channels of the mast, and bearing against the flanges. By this means the bending moment of the jib, and the weight thereon, are taken up, while the downward thrust is passed into the piston rod P. When loaded, the cranes are capable of handling fully two tons with ease.

The H beams, formerly mentioned, are built up of tee and angle bars. These have first of all to be straightened, which is accomplished, in the case of the former, by means of a 15in. hydraulic ram, and in that of the latter by an ordinary bending machine. All are then cut to the exact length of 32ft. by a cold steel saw, moving with a velocity at the periphery of about 70ft. per minute. They are now ready to be built into cast iron blocks on the drilling tables, and in building it is carefully attended to that there is a distance of 16in. between the different joints of the angles, while those of the tees are placed midway between those of the angles. To secure good butting, the end of each new beam about to be built is placed hard against the one already set up, and to which it will be joined when placed in the tube; that is, the end of the new one is brought hard up against that of the old one, tee to tee, and angle to angle.

Everything being now in order, drilling, and that through angles and tees at one and the same time, proceeds, by means of radials of the style shown Fig. 2. When this part is finished the beams are marked and laid aside till required to be placed in position on the mandrels, where, as is evident, the joints will meet as fitted in the shop. Thus this section proceeds, beam following beam till the total length required is completed. It may be mentioned that, as regards the arrangements of the tables, they are placed on each side of the line of radials, which allows building up to go on at the one side while drilling is being proceeded with at the other. To ensure accuracy in the form of the tubes, and also correctness in workmanship, the stiffening circular girders required are built within a wrought iron ring, the inside diameter of which is 12ft., this being the mean size of the tubes at present under consideration. Within this ring, and at equal distances apart, are placed ten castings, each of which occupies the same relative position to the different parts of the girder as the longitudinal beams in the completed tube. These are also of a form suitable for carrying up the various parts of the girders while being drilled. When the girder has been built in this iron frame, all the holes are marked off to templet, and afterwards drilled by a radial, the centre of the column of which coincides with that of the girder. Although some of the girders vary slightly in diameter at some parts, according to whether they are off or on joint covers, this is easily overcome by fixing temporary packing strips against the ring to suit the new dimension to which they are of necessity built. After drilling, the separate parts are all marked, removed, and now bolted together, awaiting erection on the mandrel. The angle iron rings for these girders are curved on a large cast iron segmental block. A pin is fixed into the centre of this segment, round which a large wrought iron arm carrying a curving wheel is moved. This wheel is of a form suitable to bear against the outside or inside of the bar as may be required. When the angle is heated, one of the ends is grabbed behind the wheel to the segment, and the arm is now gradually moved round. The wheel bearing hard against the angle brings it close to the face of the segment, and it thus receives the proper curve. To assist the curving a crow bar has to be used in front of the curving wheel to bend up the angle, while behind the wheel additional grabs keep it close to the segment. After the full bar has been curved in this manner the grabs are removed and the wheel run backwards and forwards several times, and then it is ready to be removed, and with a little trimming up, fit to be used in any of the girders.

Having now considered the principal parts which compose the tubes, the building and drilling of these will naturally follow. This work is done out in the open, on what is called the drill roads. These are laid down to suit the drilling machines, and at such a distance and with such a length as to allow the bracing girders and connections thereto to be placed in position, as the work stands on the ground, prior to the final erection. The roads are so arranged as to be all equally suitable of access for the steam travelling cranes used in carrying the material to position, and in building the tubes. This is accomplished by means of traversers, of which there are three, one in the centre and one at each end of the drill roads, those at the ends running on rails, at right angles, and close to the main roads, but fully 12in. lower, while the centre one is run on cross rails, on the same level as the main roads. If it is necessary to change the position of a crane it is run on to the traverser, and on it carried to the desired point, and there run off. In this way the whole of the ground is commanded by the cranes. It has already been said that the material for the tubes is placed in position by means of these cranes; the work of building, as required in any of them, will now be described.

Fig. 7 shows the style of building. First of all there is the mandrel M, 45ft. long by 5ft. diameter, raised on iron trestles T to a height, at the centre, of 10ft. from the ground. This corresponds with the centre of the outer rings of the drilling machines. The great length of mandrel required is to allow of its being carried up at the ends, when the H beams and plates are built in position. On this mandrel there are now secured, but in halves, temporary iron rings R, at the horizontal distance from each other of 8ft. To these are fixed the radiating plates P, having holes punched in the outer end for bolting on the first part of the permanent work, viz., the inner angle A of the circular stiffening girders. The same bolts are also made to carry the web plates W of these girders, on the outer edge of which is fixed the angle-irons I, for making the final conneetion to the shell of the tube. The horizontal H beams H are now placed in position, being securely bolted through the inner angle of the circular girders. On these beams are now placed the shell or tube plates S, the ends forming butt joints, while longitudinally they lap one another, this taking place over the solid flange of the H beams. The end joint of the one plate breaks opposite the centre, or solid part, of those on either side. The first plates to place in position are the inner, or those lying close against the flange of the beams, beginning generally at the bottom, and coming up on each side. Owing to the passing of the one plate beyond the other, one half of each remains free to put grabs and drawwashers on, without interfering with the placing of the outer ones in position. So soon as the outer ones have been put on, and fixed in a similar manner, there is passed round all a couple of angle iron rings, for binding and drawing them up to their proper position. The tightening up is done by means of iron wedges between the plates and the rings. After the bottom plates have been fixed in position, the tube is borne up by wooden blocks, built between it and the cradle underneath. The true position of the tubes, both as regards horizontal distance apart and height, is found by means of a theodolite, placed at one end of the roads, on a fixed platform, in a position such that when it is in line with a stationary point at the other end it always fixes the centres 120ft. apart throughout, and horizontally in the same plane. If the centre of the mandrel is not in this line, then it is made so by being raised, lowered, or shifted sideway to suit. When the mandrel is right, the tube must of necessity be so also, seeing the centres coincide.

When the building of one ring of plates has been completed, the drilling machine is moved forward, the blocks in front being taken out of the way and rebuilt behind as it is travelled along. To enable the drilling to go on continuously, the building of the tube in front is being proceeded with while the machine is still at work on the portion immediately behind. These tube drilling machines—of which there are four—are shown by Figs. 1 and 14. Each is self contained, and on being run along the rails carries all with it. The principal parts are, the wrought iron underframe or carriage A, on the one side of which is fixed the engine E and boiler B, and two large cast iron rings C, firmly bolted to the main cross girders. These rings have an internal diameter of 13ft., sufficient to enable them to pass freely round the tube when the machine is being moved along. Five cast iron slides D are fixed thereon, and held in position by means of small slipper blocks F, fitting into a recess in each of the rings C. On each of the slides are the two heads H H. Each head is provided with a single drill, and is capable of being rapidly run from one point of the slide to another by rack and pinion gearing. The slides are kept in position, and also turned round the rings C, in either direction, by means of two worms W, carried in brackets F, one gearing in each ring in the circular racks R. These racks being bolted to the rings, serve also as guides for steadying the whole upper portion of the machine. All the drills point to the centre of the tube, and having, as shown, both a circular and longitudinal motion, can with ease be made to reach every hole in any part of the structure, some of which are through a depth of as much as 4in. of solid metal.

It might be here mentioned that some of the slides were specially designed to overcome the difficulty of drilling, say, a flat part in any of the tubes. The difficulty lies in the fact that the drills on any of the fixed heads always point to the centre of the tube, whereas in the case just mentioned the holes require to be drilled at right angles to the special or flat part. The mode adopted to overcome this was to make both ends of each slide circled, fitting them into separate heads, which in turn were bolted to the slipper blocks F, as in the others. On the head at one end is placed a worm, while on the same end of the slide there is keyed a wheel into which the worm is geared, by turning which the slide can be made to place and keep the drill pointing in any required direction.

The whole of the drills are fed into their work by an automatic arrangement, the motion being imparted to the longitudinal shaft L by a band driven off the main driving pulley. On this shaft slides, and by it also are driven, the worms W^1, necessary for turning the worm wheel I, which at will can be made to drive the hand wheel R, thereby feeding the drill into its work. At one end of each of the main slides is overhung the driving pulley P, the power being transmitted from the engine to the whole of these by means of a cotton rope, guided where necessary by supplementary pulleys. The slack is taken up by a shifting quadrant Q, moving about the engine shaft as a centre, assisted by auxiliary pulleys on the wrought iron frame close by the engine.

When starting work on any tube, a drilling machine is moved forward to the point at which operations are to begin. Each of the five slides is now moved round the rings until the points of the drills face truly any series of holes in the longitudinal beams. The holes in this line, or series, are all drilled, two drills being at work on each line, then the slides are again placed so as to suit a new set, and so on until the whole of the tube commanded by the machine in its present position is finished. This is equal in length to 8ft., and includes the full circumference of the tube. The number of holes in such is about 800, and the time required to drill all, when working continuously, is from twenty-four to twenty-eight hours, varying thus much principally on account of the difference of thickness of the various parts of the tubes. The machine is in like manner made to drill the whole length of the tube.

At several of the ends of the first four of these tubes are presently being erected the skewbacks, each a complicated connection of five different tubes, including one end of these just described and also several heavy bracing girders. Into this, however, it is not proposed to enter at this time. At present other tubes are being treated in a manner similar to that already described, which shows, if anything is yet required, that special work can only be grappled with to advantage by the free use of special plant.

* Institution of Engineers and Shipbuilders in Scotland.

ADDITION TO THE GERMAN NAVY.—The ironclad "E" was launched for the German Government on December 20th, from the yard of the Vulcan Company at Bredow, near Setttin. The vessel just launched was originally designed to be the last of the Sachsen type of armoured corvettes, but varies, as completed, considerably from that class. While ships of the latter have each a displacement of 7400 tons, the ironclad just launched has a capacity of only 5200 tons, so that she is much smaller than the ships of the Sachsen class. The latter carry six guns, but the ironclad "E" has 12. The vessel received the name of Oldenburg at the launch. The Oldenburg is intended principally for service in the Baltic. She has two compound engines of four cylinders each, and a total horse-power of 3900, and is equal in the latter respect to the Bayern, Baeden, Sachsen, and Württemberg, formerly known as ironclad corvettes of the Sachsen class, now, owing to the new classification the German Navy, simply as ironclad ships. The Oldenburg is 75 metres (246ft.) long, with a beam of 18 metres (59ft.), and a draught of water of 11 metres (36ft.). She is a ram ship; her casemate has a compound armour 33 centimetres (12·87in.) thick, supplied by the well known Dillingen Works. The casemate contains six twenty-four centimetre (9·36in.) guns, three on each side. There are also two guns of the same calibre on the forecastle, and four 15 centimetre (5·85in.) guns on the poop. The great strength of the Oldenburg consists in being able to maintain a heavy fire besides from her broadsides, also over her stern and bow, which is an important feature both for attack and defence. The Oldenburg is to receive also three 7 centimetre (2·73in.) revolver guns and two 8 centimetre (3·12in.) boats and landing guns, as well as one torpedo gun forward and three similar guns aft, fired below the water line. The principal features of the Oldenburg are comparatively small size combined with heavy armour and armament, the latter of which will act equally powerfully all round, as well as great speed. The latter is not stated, but it will be greater than that of the other ships of the Sachsen type, which is 14 knots. The Oldenburg will form a very valuable addition to the German Navy.

THE RATING OF MACHINERY.

AT the Northumberland Quarter Sessions, held on the 9th inst. at the Moot Hall, Newcastle-on-Tyne, before Sir Matthew White Ridley, Bart., M.P. (chairman), the Rev. Dixon Brown, Mr. J. P. Mulcaster, and Mr. J. Burdon Sanderson, the appeal of the Tyne Boiler Works Company against the overseers of the poor of the township of Longbenton and the Assessment Committee of the Tynemouth Poor-law Union came on for hearing. This was purely a test case, the appellants only being representative of a large combination of shipbuilders, boiler-makers, and other users of large machinery in the North of England, specially formed in order to test the law on the subject, while its decision is anxiously looked for by manufacturers all over the country. Mr. R. T. Reid, Q.C., M.P., Mr. Cyril Dodd, and Mr. J. E. Joel were for the appellants; Mr. R. E. Webster, Q.C., Mr. John Edge, and Mr. Hans Hamilton for the respondents. The case excited considerable interest, and the court was attended by members of all the principal engineering and shipbuilding firms in the district, as well as by the representatives of several railway companies and of some trade societies.

Mr. Reid, in opening, said this was an appeal against a rate made on the 21st June, 1884, which had been entered and respited. It was a rate made upon premises in the occupation of the Tyne Boiler Company, and comprised, including the part covered with buildings, 5100 square yards. The gross rateable value against which they appealed was £590, and the net rateable value was £501. He ought to say that though the appeal was confined to this particular rating, it was in every sense a test case, and he believed that both sides were fighting it as such. The question shortly was whether the machinery in this factory was rateable or not?

Mr. Webster: You contend that no part of the machinery ought to be rated?

Mr. Reid said, roughly speaking, that was so. What the appellants said was that the rating machinery in a place of business, although, as he would point out presently, was not absolutely unprecedented, yet, substantially, was an innovation. It had been done in one or two places, and perhaps acquiesced in; but so far as the general practice is concerned, he stated, and he thought he would be able to show, that it was a complete and absolute novelty. Before the statutes of William IV. and an early statute of Queen Victoria, when rating was regulated entirely under the statute of Queen Elizabeth, every one, of course, would recollect that personalty was rated—indeed, ships were rated; but since those statutes it had been agreed that nothing was rated except that falling under the denomination of realty. The question was, what was to be part of the personalty and what part of the hereditament; and the chief and greatest difficulty in arriving at a decision had been in the case of what were called fixtures. But the rule had been laid down in certain cases, and he did not think he and his learned friend would dispute about the principle of the law, however much they might differ about the application. The learned counsel went on to quote Justice Blackburn in the case of the Queen *v.* Lee, in which his lordship said: "The rule laid down has been that where the things are attached to the premises, so as to be part of the premises, although they are removable afterwards, still they are part of the premises, although there may be a right to remove; but if a thing or a chattel be merely fixed to the premises, and so far fastened to the premises as to be still chattels, but fixed and steadied for the purpose of use, then they remain chattels altogether;" and then his lordship proceeded to say there were two things to be taken into consideration, "first, the mode of annexation to the soil or fabric of the house and the extent to which it is united to them, whether it can be easily removed *integre, salve, et commode* or not without injury to itself or the fabric of the building; and secondly—and this is what I am calling attention to on the object and purposes of the annexation—whether it was for the permanent and substantial improvement of the dwelling in the language of the civil law, *perpetui usas causa*, or in that of the year *pour un profit de l'inheritance*, or merely for temporary purposes or the more complete enjoyment and use of it as a chattel." That he took to be the principle of the law applicable to the present case. He cited the Halstead case, in which machines which were steadied on the floor with screws were held not to be rateable. In Laing *v.* the Overseers of Bishopwearmouth, which was in reference to machinery in a shipyard, the machinery was very similar to that in the case before them, and it was decided that it was assessable to the poor rate; but he contended that that was a finding on the facts, and not on the principle of law he had before quoted. The case was never decided at Quarter Sessions, but the findings were agreed on by counsel; but he argued that one of the findings was incorrect, inasmuch as it stated that the machinery was intended to be "permanently used in the shipbuilding and repairing yard," whereas it could have been easily removed without injury to itself or the soil or fabric of the premises. This was a most important case, and they were all anxious to have the law settled; and he did not wish to have any ambiguous or doubtful expressions used as the word "permanent" to preclude them from having the real facts of the case brought before the Court.

Sir Mathers White Ridley: The word permanent, as applied in Laing's case, merely means the use year by year, so long as the place was carried on as a shipbuilding yard.

Mr. Reid disagreed with this interpretation, and argued that by permanent was meant the use for as long a period as things generally last; and after admitting the rateability of the smithy fires, which were built into the wall, proceeded to describe the machinery it was proposed to rate, and which might be put into two classes, viz., power and machines. He allowed that a rule had grown up by which power was held to be rateable, but maintained that, by the ruling in the case of the Queen *v.* Lee, it should be exempt. The principal machinery consisted of punching, slotting, drilling, and rivetting machines. These were in some cases steadied by their own weight, in some bolted up against a brick wall, and in others screwed on to concrete beds. In no case could the machinery be said to be permanently annexed to the premises within the meaning of the cases he had already quoted to the Bench. The machines were separate and distinct from each other, and were movable at will by being taken down and put up either for repairs or re-arrangement, or from a change of the use of the building. They could be removed without damage either to the machinery or to the building, and they were commonly bought and sold, renewed, and removed as chattels. The machinery was, in fact, annexed by the tenants, and that was the practice of the district. These were the facts of the case. He could show that in a comparatively short space of time the premises had been used by no fewer than four different kinds of industry—as chemical works, as a shipbuilding yard, as an engineering yard, and now as boiler-making works. It was manifest on these facts that the machines in question were merely chattels, and that, however they were annexed or attached, there was never any intention of making them part of the freehold, or doing anything for the purpose of benefitting the inheritance. In the Bishopwearmouth case there was some expression with regard to enhancing the value of the property; but the presence of the machinery could not enhance the reality, but only the undertaking, regarded as a business and profit-making undertaking, just as a Raphael picture might temporarily enhance the value of a gallery without adding anything to the value of the freehold.

Mr. William Boyd, of the Wallsend Slipway and Engineering Company, who had formerly occupied the premises, gave evidence bearing out the opening statement. He said the attachment of the machines was merely to keep them steady and to resist the pull of the belt, and they were frequently removed from one part of the shop to another.

By Mr. Webster: His works were situated in the Tynemouth Union, and his firm were members of the combination contesting the present case. He admitted that the shear legs could not be used in any other part of the yard than that in which they were at present erected, without laying down another foundation, and that the east wall of the works, to which the shafting was attached, was thicker than the west wall, and also buttressed at intervals, and agreed that it was likely this had been done to support the brackets carrying the main shafting. All the machinery was driven by straps from this main shafting. There was not a machine in the place that was not easily applicable to other industries; indeed, there were two or three machines they could do without. They could substitute hand labour for rivetting and drilling machines, but not for any of the other machines that he could remember. Mr. Webster here stated that there would be no dispute as to the facts as stated by Mr. Boyd, and that unless the appellants intended proving any new point, he was prepared to dispense with evidence on the part of the respondents, and proceed at once to argue the case.

Mr. Reid intimated that there were no other facts of importance to prove, and that he on his side would only call two other witnesses in order to shorten the case as much as possible.

Mr. Nicholson, the manager of the appellant's works at Walker-on-Tyne, was then called, and gave similar evidence to that of Mr. Boyd.

Mr. Joseph Potts, jun., architect and surveyor in Sunderland, said he had large experience in valuing and letting buildings, and had been engaged in a great number of rating cases. So far as his knowledge and experience went in this immediate neighbourhood, the rating of machinery began about twenty years ago, and at that time, in conjunction with Mr. T. F. Hedley, of Sunderland, he valued manufacturing machinery for the purposes of rating. He did not know what the general practice was throughout England. Previous to that he thought only land and buildings were taken; and he believed, though he might be mistaken, the rating of machinery began on a suggestion from Mr. Hedley that they should take the capital value of the machinery, add to it the value of the land and buildings, and rate the whole. In this district the class of machinery in question was invariably annexed by tenant.

By Mr. Webster: Laing's case was fought in 1878, and twelve or thirteen years before that he had valued machinery for rating purposes. He had never investigated the practice in rating machinery or otherwise prior to twenty years ago. He did not know that Mr. Hedley, prior to twenty years ago, had valued machinery for the purposes of rating in other parts of the country; but he had since learned from the law reports that machinery had been rated forty or fifty years ago. He had advocated the manufacturers' case in the newspapers.

Mr. Reid did not call any further evidence.

Mr. Webster said he should call no evidence, and proceeded to address the Bench for the respondents. He contended that it was idle to say that this was any new question requiring a case stated, and whenever the question had been contested during the last fifty years the unanimous decisions of the Court of Queen's Bench had ever been in accordance with the decision given not long ago in the Bishopwearmouth case. The machines there concerned were in so many words identical with those described by the witnesses and shown in the photographs that day. So far from resting on any special statement, the Bishopwearmouth case rested on the facts as to what the machinery really was. Every point was taken, and it was specifically described that the machinery could be taken out, and could be used in any other factory, and that the removal of the bolts had nothing whatever to do with the freehold or the construction of the machinery itself. The argument with regard to the word "permanent" had been exaggerated to a most extraordinary extent. All that was ever said about permanence was that so long as there was a shipyard there so long would those machines be there. The word "permanence" was used as meaning the machinery was necessary for the premises so long as they were used for the purposes of the yard. If they were altered or taken away, of course his friend was entitled to have the benefit of it in any future rating. The question for the Court was not whether machinery or chattels were rateable, but whether the machinery used as it was enhanced the value of the hereditament, and that was the only form in which the question could be put. The learned counsel went on to quote a number of cases in support of the arguments he was laying before the Court, and said for rating purposes it was immaterial whether the machinery belonged to the landlord or the tenant. In conclusion, he contended that the case did not differ in a single point from the Bishopwearmouth case, in which judgment was given for the respondents.

Mr. Reid replied on the law of the case, and contended that the preponderance of the authority of the higher courts was in his favour. The principle that chattels were not rateable, he said, was undisputed; and, according to the decision in the Queen *v.* Lee, the Tyne Boiler Company had a right to have their machinery exempted from the rating assessment. Part of the premises or not part of the premises was the question which was debated through the whole of the judgment, and in this case the machinery was clearly not part of the freehold. The authorities on the subject were contradictory; and even if the Bench were against him, he trusted they would give him a case for a higher court, in order that they might ascertain which was the right law on the subject.

The Chairman—after a short consultation—said the Bench did not entertain the shadow of a doubt that this property had been properly rated. They were unanimous on that point. But they had a difficulty with reference to Mr. Reid's request for a special case. They were anxious to meet the convenience of all parties, but it seemed somewhat strange to state a case as to whether they were right or not on a point on which they had no doubt.

Mr. Reid said it was a matter affecting millions and millions of money, and they were desirous of taking the question to the House of Lords in order to have it definitely settled. The appellants had no objection to the Court saying they had no doubt themselves on the matter, but considering it was a matter of the utmost importance, they had consented to state a case. Then no one could suggest the Court had acted improperly.

Mr. Dodd said that there were other similar cases in the south awaiting the decision of this case in a court of law.

The Chairman said the Court of Queen's Bench might refuse the case.

Mr. Dodd: Let them refuse. If they do refuse we accept the responsibility and our clients pay the costs.

Mr. Webster left the case entirely in the hands of the Bench.

The Chairman said they would certainly grant this special case, because the former case was argued on an agreement on the two sides before going into court.

Mr. Webster asked for an order to dismiss the appeal with costs.

The Chairman then dismissed the present appeal, with costs to the respondents, and said each party should have an opportunity of seeing the special case before it was submitted.

The case then terminated.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, January 3rd.

THE commercial interests of New York are anxiously waiting for the first signs of improving activity. Manufacturing interests throughout the middle and New England States have been curtailing production for months past, reducing wages and devising economies in various directions to gather strength for 1885. Our leading commercial authorities show 11,600 failures for the year, as against 10,299 for 1883. The failures of 1884 were 12 per cent. greater than 1883, and liabilities 37 per cent. greater. It is estimated that the failures of 1885 will reach 12,700, and that the total liabilities will fall very little short of 250,000,000 dols. In the Province of Ontario there are 1545 manufacturing concerns, and seventy-two idle. In the Southern States there are some indications of further improvement in the iron and textile interests. In railroad circles no improvement is in sight; there is a large amount of projected construction depending upon the number of tendencies, such as improving crops of wheat and corn and cotton, and improving demand in price, which the more sanguine in the commercial and manufacturing circles are anticipating. The argument is used that the present producing capacity of the country at large is considerably below the average consumptive requirements, and that an increase in demand is as inevitable in 1885 as it was in 1879; no general improvement is probable until the depression in progress has accomplished its work. Large volumes of idle capital are waiting employment, and in consequence of the lack of demand the rate of interest is low, and the bank facilities are extending to sections of the country heretofore but meagrely accommodated. General trade and manufacturing interests are greatly depressed. The cotton crop is lighter than usual, and that fact is leading to speculative movements of immense proportion.

The sugar interests are suffering from a heavy increase in production, and from the West Indian surplus thrown into the market by reason of the loss of the European market. The iron interests are waiting for a reviving demand, but thus far the tendency has been to still lower prices, by reason of curtailed requirements among railway and bridge builders.

Pig iron industry is much depressed, by reason of the high price of lake ore in the West and the high-priced coal in the East. The ore and coal monopolies, aided by the transporting companies, have been able to hold the price of raw material, for years past, at a figure which has rendered, and which still renders, it impossible for manufacturing interests to reap legitimate profits; and in consequence of this there are indications of an organised protest. The eastern pig iron manufacturers are organised, and request lower prices in coal; but the Schuylkill and Lehigh Exchanges, which met in Philadelphia last week, refused to make any concessions on January prices. The Reading Company, the heaviest producer, which supplies from ten to eleven million tons of coal annually, has ordered twenty-one of its collieries to remain idle, and will continue a number of its other collieries in idleness, with a view of preventing any over-supply of coal and ore, that outside prices may be maintained. The policy is hurtful to the manufacturing interests, but they have no choice. Meetings have been held in Pittsburg, to take action on high-priced lake ores and high-priced labour.

Puddling is 5·50 dols. per ton. Rolling and all other kinds of skilled labour has risen in proportion. Lake ores range from 6 dols. to 7·50 dols. per ton, and in consequence of these drawbacks Western Pennsylvania is threatened by competition from other sections. The Southern pig iron makers are likewise discussing the situation and endeavouring to obtain lower freight rates on their pig iron.

The Thomas Iron Company, one of the leading iron companies in Pennsylvania, has determined upon an investment of a large amount of blast furnace company capital in Alabama, by way of imitating the policy of Sir Titus Salt, who, with some assistance, has erected a 2,000,000 dols. plant in Tennessee. The competition of the past twelve months has done more to stimulate a disintegrated impulse in the iron trade than anything that has occurred for twenty years. The Pennsylvania iron men have been obliged to shade prices heavily to save themselves, and several of the leading iron-makers are the owners of large properties in the Southern States. A large amount of property in the Southern States is practically worthless, because of the development in other sections where ore and fuel can be obtained at lower costs.

Present quotations for forge are 15 dols. to 16 dols. at tide water; foundry, 17 dols. to 18 dols.; Bessemer nominally 19 dols.; spiegel, 26 dols. for 20 per cent. There is but very little demand for Scotch iron, and recent sales indicate weakening. All kinds of merchant iron and steel are in excess of demand, and mills are working only from 50 to 60 per cent. of their capacity.

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

(*From our own Correspondent.*)

THE meetings of the iron trade in Wolverhampton yesterday, and in Birmingham to-day—Thursday—were not productive of any large amount of business in the finished iron branch, nor would it seem that many orders have come out since the quarterly meetings last week. The trade done at these gatherings was disappointing, and it is, as yet, rather soon to look for the orders which, in a greater or lesser ratio, always follow. Merchants have, as yet, scarcely settled down to real business. In two or three weeks' time perhaps orders will be arriving more freely.

Liverpool merchants are understood to be in receipt of rather more cheering cablegrams from the United States and Canada, and this news was about the most encouraging which was current on Birmingham 'Change. Advices from Australia speak of continued low prices, and best Staffordshire bar makers had to face this circumstance in forecasting the probabilities of the Australian trade in the new quarters. Some time ago competition in Australia from Leicestershire iron makers, which was becoming serious to certain prominent Staffordshire bar houses, had the result of inducing the latter to revise their terms. The consequence was that the orders were retained by the Staffordshire mills; but there is now little, if any, room left for further giving way in quotations.

Export buyers for India are seeking quotations for contracts, and for several of the South American and European countries the demand is equal to that recorded during several months past. There was some expectation that a reduction might have been declared in marked bars in Birmingham last week, but the expectation is not realised. It is the opinion of makers that no good purpose would be served by such a step at this juncture. There is no belief that it would bring out any more orders; the only result, it is thought, would be to still further depress prices.

In actual negotiations, prices are rather easier this week than at the quarterly meetings, since there is always a tendency at those gatherings to keep them up as high as possible—generally a little above the selling standard; but now that those gatherings are over, rates assume their normal level.

In other than very few instances the prices at which marked bars are going off for the home trade is £7 5s. to £7 per ton, and in the case of export business something under these figures is taken. Good unmarked bars are £6 10s.; fair qualities, £6; and the minimum qualities, £5 10s. Common export hoops generally quoted £5 15s. to £5 17s. 6d., but some merchants state that they can purchase at £5 10s. at the works. Nail rods, £5 12s. 6d. upwards; and tube strip about £5 12s. 6d. to £5 17s. 6d. Orders for rivet iron are not very numerous, but enquiries are rather plentiful. Several Government orders for girder iron have been allotted to this district during the last few days.

The demand for angles for local users is just now very fair, and makers speak well of the way in which orders are coming in. Certain of them are booked well forward; here and there with good orders up to Midsummer. The work has, however, to be accepted at small prices, on the basis of about £6 per ton for common sorts.

The sheet trade is not particularly brisk at date, though some tolerably good contracts have during the past two or three weeks been entered into. Galvanisers and merchants are the best buyers. Fair quality merchant's singles are to be had at £6 12s. 6d., while galvaniser's singles are £6 15s. to £7 2s. 6d.; working up lattens are £8 5s. to £8 10s. for merchant purposes. Galvanised sheets of 24 gauge are this week priced by Birmingham makers at £11 5s. to £11 10s.—prices which, compared with January of 1884, are a reduction of some 30s. per ton. An attempt has been made to enlarge the sphere of the Galvanised Sheet Makers' Association, with a view in part of obtaining more uniformity in prices, and the quarterly meeting of the Association was adjourned for a month or six weeks.

Thin sheets for working-up purposes are quoted by Messrs. John Knight and Co. at £10 10s.; steel sheets, £12 10s.; and charcoal sheets, £19 10s. Tin-plates are quoted by the same firm at Cookley, coke qualities, 20s. per box I.C. quality; and Cookley K. charcoals, 25s. I.C.

The plate trade remains quiet. Tank sorts can be got at not much above £7 at works, or £7 15s. London, and common boiler sorts at £7 10s. at works, or £8 5s. London. More reliable boiler qualities are £8 to £8 10s. at works. Some Staffordshire middlemen are, however, placing orders for tank plates with North of England makers, which they get delivered into the Thames at £7 10s. per ton. The North of England steel masters, too, are likewise continuing their competition with this district. They are offering Bessemer steel boiler plates at £8 10s. delivered here, and Bessemer steel tin bars for tin-plate making at £5 10s. delivered.

Native pig iron rules tame, though some quarterly contracts have recently been booked, more particularly for second and third-class qualities. Prices are the great drawback. Firms who demand 62s. 6d. for hot blast, all mine pigs, are unable to make sales, and have to rest content keeping their stocks. 57s. 6d. and 55s. are about the selling prices. The output of the present time of the Lilleshall Iron Company, Shropshire, is somewhere about 900 tons of pigs weekly, the produce of three hot and one cold blast furnaces. Second native pigs are 45s., and third-class 36s. 3d. to a little less.

Sales of Derbyshire and Northampton and similar brands of pigs are gradually increasing. A few agents reported to-day that during the last three or four weeks they have made some capital sales on the basis of 41s. for Northamptons and 42s. for Derbyshires delivered.

Forge, mill, and furnace coal is in very dull demand. Forge coal ranges from 5s. to 6s. per ton, mill coal from 6s. 6d. to 8s., and furnace from 8s. to 10s. per ton. Cokes and ironstone are only in moderate request. Durham foundry cokes are 23s.; South Yorkshire cokes, 15s. 3d. to 15s. 6d.; and South Wales forge sorts about 14s., all delivered. Northampton ironstone is quoted an average of about 6s. per ton delivered. Ulverstone red hematite ore is quoted at 10s. per ton at the mines, or 13s. 6d. delivered to Saltney Railway Station. A sale of 5000 tons to one consuming company was reported to-day.

The unemployed in Birmingham are following the example of their fellow-operatives in some other towns, and are beginning an agitation to secure temporary work. Numbers of men have applied to the Mayor for employment on the Corporation works. On Thursday a mass meeting of the unemployed was held in the open air at Aston, to devise means for their own relief. There are more operative engineers unemployed in and about Birmingham now than for a long time past.

It is at present too early to look for much life in the shipping trade as to hardwares, but such as it is, most is doing with Melbourne and Sydney, and with certain of the South American markets. The East Indian demand is below the average, and the Cape trade is very slow in improving. Prices all round are still kept down by the low rates for iron, copper, tin, and other raw materials.

Mr. John Head, F.G.S., London, read, on Saturday night, to the Mill and Forge Managers' Institute, a paper upon "Heating by Radiation as Applied to Regenerative Gas Furnace Working at High Temperatures." Assisted by diagrams, Mr. Head went fully into the comprehensive merits of the Siemens furnace, and dwelt upon its application to forge and mill work. A brief discussion followed; and the author was thanked for his paper, which it was determined shall be printed in the "Transactions" of the association.

Satisfactory profits are being made by the Birmingham and Aston Tramways Company. At their meeting on Tuesday it was resolved to pay an interim dividend at the rate of 10 per cent. per annum.

The Wednesbury Local Board having received the sanction of the Public Works Loan Commissioners to borrow £50,000 for the erection of sewage works, they have determined to advertise for specifications for contract No. 2.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—There is still an absence of any indication of improvement in the condition of the iron trade of this district, and there would seem to be, if anything, even a more depressed tone in the market. The absence of any weight of business coming forward at the quarterly meetings has tended towards a less hopeful feeling, or at any rate to emphasise the want of confidence in the future which has prevailed of late, and although makers do not openly quote any lower prices, there is a weaker tone in the market. There are, however, some fair inquiries stirring which would possibly lead to a considerable business being done if makers were disposed to entertain the offers put forward, but these are mostly for long forward delivery at very low figures, and there seems to be a strong determination on the part of many of the makers to hold back from pushing business on the basis of the prices that buyers apparently have in view. There is more willingness to book pig iron over the first half of the year or even longer at current rates, but any further concessions sellers, as a rule, are not at present disposed to make, and the result is that beyond a few orders to cover requirements during the ensuing quarter, which generally are of no great weight, there is very little being done.

The Manchester iron market on Tuesday brought together a moderately good attendance, but business was only slow. For pig iron, local makers—who are fairly well off for orders—are still firm at 41s. to 41s. 6d., less 2½, for forge and foundry qualities delivered equal to Manchester, and good district brands are quoted at about the same figures; but there are sellers who are open to go as low as 40s. to 40s. 6d. per ton, less 2½, delivered into the Manchester district, to secure orders. Hematites, if anything, are rather easier. For good brands of foundry, makers in some cases hold to 54s., less 2½, delivered here, as their minimum quoted price; but there are sellers who would readily take 53s. to 53s. 6d. for anything like good orders, and special sales have been made at a little under these figures. In the manufactured iron trade orders are reported to be coming forward very slowly, and some of the local forges are getting very short of work. A few of the leading makers still adhere to £5 12s. 6d. per ton as their minimum for bars delivered into the Manchester district; but there is no difficulty in placing orders for good ordinary brands at £5 10s., and it is only in exceptional cases that much above this figure is being actually got. Local made hoops are quoted at £6, and sheets at about £7 per ton.

There is no material change to notice in the condition of the engineering trades from what I reported last week.

In railway carriage and wagon building, as I have previously reported, there is a good deal of activity. During the past week I visited the large works of Messrs. Ashbury and Co., at Openshaw, near Manchester, and they presented a marked contrast to the condition in which I found them when I went over them a few years back, with the chief part of the plant lying idle, and scarcely an order of any weight in hand. On my present visit I found every department busy, and I had an opportunity of inspecting an order for railway plant just being completed for one of the Indian princes. The order comprises the whole of the rolling stock for a line about seventy miles in length, including saloon car, first and third class carriages, with covered and open wagons for the conveyance of goods, and as the whole of the stock has been built from special designs, which are quite of a novel character, a short description will be of interest. The main feature has been to construct rolling stock of the lightest possible character, to travel over a 2ft. 6in. gauge. The carriages are built up with sheet iron panels upon channel iron under-frames, with steel wheels and axles, and they are so light that no expensive permanent way is required, a feature which would be found of considerable advantage where what may be termed pioneer railways might be required to open out trading districts in the various colonies. With, however, all their lightness, strong, substantial construction has been secured. The passenger cars are commodious and comfortably fitted up, and the wagons are well adapted for the conveyance of grain and other goods. Messrs. Ashbury have also in hand the construction of the whole of the rolling stock for the Mersey Tunnel Railway, and the carriages for this company are being fitted up with the most modern appliances, including an electrical signalling apparatus. The firm is also building for the Besbrook Tramway Company a special tramway car, to be driven by electricity on Dr. Hopkinson's principle. The car, which is carried on two four-wheel bogies, is divided into three compartments, two for passengers and the third to contain the dynamo and gearing, which are carried on the front bogie. The driving power is carried through an endless chain from the dynamo to a drum keyed on the axle of the carriage wheels. Amongst other orders the firm is just completing a very large one for the Great Eastern Railway Company, which has included 130 first, second, and third-class passenger carriages, twenty-five horse boxes, 130 cattle and 100 covered goods vans. They have also orders in hand for other home railways, carriage contracts for Spain, iron wagon for South Australia, and iron under framing for the Bombay and Baroda Railway, with a good deal of other railway plant work.

Messrs. R. and J. Dempster, gas engineers, who for many years have carried on business at Elland, near Halifax, have taken the large works at Newton Heath, formerly occupied by the Railway Steel and Plant Company. These works occupy upwards of seven acres, of which about four acres are under cover, and they have been lying idle for a number of years, but Messrs. Dempster have now fitted them up with new tools for the construction of all descriptions of gas works apparatus, and the re-starting of so large a concern cannot fail to give a stimulus to the trade activity of the district.

The Darlington Forge Company has introduced a novel feature in the application of steel to colliery underground work, which may lead to a large demand. It is executing considerable orders for large sections of channel steel, which is to be used for roof-supporting beams in the pit workings in the place of wood at present usually employed, and steel props are also being made to replace the wooden props. The first cost of steel is of course in excess of that of the rough timber now used, but an ultimate saving will be secured, in that the steel can be constantly re-used for the same purpose, which is not the case with wood, whilst a very great advantage is obtained in the lessened space occupied as compared with the present heavy timbering, and which thus affords a much better working headway, a matter of very considerable importance in shallow seams.

The coal trade has shown a little improvement owing to the colder weather having given rather more briskness to the demand for house fire coals, but there is still no push, and for other classes of fuel for iron-making and steam purposes there is only a moderate inquiry. Prices, if anything, are steadier, but are not more than maintained at late quoted rates, best coals averaging 9s. up to 9s. 6d.; seconds, 7s. 6d. to 8s.; common round coals, 6s. to 6s. 6d.; burgy, 4s. 6d. to 5s.; best slack, 4s. to 4s. 3d.; and common about 3s. to 3s. 3d. per ton.

There has been a fairly active trade doing for shipment which has kept some of the collieries busy, and there has been a good deal of filling up out of stock during the last week or so to supply orders, but prices have continued low, and delivered at the high-level, Liverpool, or the Garston Docks, steam coal has not averaged more than 7s. 3d. to 7s. 6d. per ton.

Barrow.—The pig iron trade, I have to report, still remains in a depressed condition. Sales being few and inextensive, consumers' wants are at present very limited, and they withhold orders as long as possible. When forced to buy, the business they offer is inconsiderable and inextensive, and the prices so low that makers realise little, if any, profit. Although so little business has been transacted of late, except for forwards, the output of the district has not been restricted. This being the case, stocks would have increased had not deliveries been large. It is certain that if trade continues without life much longer the number of furnaces in blast will have to be reduced. The amount of metal now on hand is quite sufficient to meet any sudden demand that may arise. There is no variation in prices, mixed Bessemer samples remaining at 45s. per ton. In some cases makers are asking 1s. advance on this for orders for forward delivery. The steel trade shows no improvement. The large works at Barrow, which have been closed for several weeks, commenced operations again this week. Both steel rails and merchant qualities are in fuller request. Prices for the former remain at £4 15s. per ton net at works. The shipbuilding industry is very stagnant, as orders are difficult to obtain. Little activity is at present noticeable at any of the yards, but new contracts are expected. The iron ore trade has not improved, and buyers of hematite do not seem inclined as yet to give any more than the price which has been general for some months back, viz., 8s. 6d. to 10s. per ton. Sellers are not anxious to enter into large contracts at present rates, as they are awaiting an opportunity to advance prices. The embargo on Spanish ore is expected to have a beneficial effect upon the trade of this district. Coal and coke continue in quiet demand.

The erection of the new Town Hall at Barrow at a cost of £50,000 to £70,000 is proceeding satisfactorily, the roof having been almost completed and the tower being half built. A new clock has been ordered from a Croydon firm at a cost of about £1000.

Mr. J. Fell, of Leamington, who has the contract for building the new high-level bridge at Barrow, is making satisfactory progress with the foundations, and a large number of old houses have been removed to make room for this improvement.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

SOME months ago I mentioned that local coalowners were contemplating the establishment of an Insurance Association, to reimburse members whose collieries may be set down during wages' disputes. The first meeting of the newly-formed association was held at Sheffield on Tuesday. The proceedings were not opened to the press, and, I am informed, were entirely confined to settling the basis of the new organisation. It is expected, however, that one of the first subjects to which the association will address itself will be to obtain a return of the 10 per cent. conceded in the autumn of 1883, which the colliery proprietors state ought never to have been granted, and ought certainly now to be taken off. Among other collieries represented at Tuesday's meeting were Thorncliffe, Nunnery, Aldwarke, Car House, Eckington, Wharncliffe, &c. With the exception of Denaby Main, all pits of first-class importance are stated to have joined the federation.

My paragraph of last week about steel rails has excited some comment. The price is regarded as very extraordinary, and one trade organ copied the announcement under the heading, "Is this true?" It is quite true. For the contract—which amounted in all to 15,000 tons — there were only five competitors. All were in the Steel Rail Makers' Combination, except one. The tender accepted was at the rate of £4 8s. 6d. a ton, which was the quotation of a firm in the Association; another firm, also in the Association, quoted £5 4s. 2d. per ton. The tender of the firm outside the Association has not been disclosed, but it is known to have been somewhere between these two figures. The interest centred in the variation of figures given by the two firms in the Association, and particularly in the quotation of £4 8s. 6d. a ton, which, deducting carriage—as the rails had to be delivered at Doncaster or Retford—reduced the price to £4 5s. per ton. The object of the Association was to raise values, and they succeeded in doing so for a time, but £4 5s. a ton is an absurdly low rate for rails, and is only explicable on the ground that it had been determined to under-quote the one firm which persists in keeping out of the federation.

A year ago the Warrington steel wire drawers effected a reduction of 20 per cent. in wages, after a severe struggle. Since that time the Sheffield manufacturers have been working under the disadvantage of paying their men so much more wages. The result has been that the effort has not succeeded, and it became apparent that if the business was to be kept in Sheffield the local employés must consent to a reduction. The men have held several meetings, at which moderate counsels prevailed. It is expected that they will agree to a modification of wages amounting on an average to a reduction of 20 per cent. It should be mentioned that the change does not affect men working on ordinary classes of wire, but only applies to makers of crucible and patent wire for rope and similar purposes.

The boiler explosion at the Parkgate Ironworks, which killed two men, has been carefully inquired into by the district coroner, with the result that the jury have returned a verdict that the explosion was due to "the boiler being insufficiently supplied with water, but as to how the insufficiency arose there was not sufficient evidence to show."

A Sheffield manufacturer—who is not engaged in any of the trades mentioned—has received a letter from his son, who is at Sydney. He writes that foreign competition is greatly injuring the English colonial trade. English agricultural implements, axes, shovels, forks, picks, hoes, &c., "are not in it," he says, with the American Disston's saws; though 20 per cent. dearer, they are preferred to English productions. He adds:—"Our people are importing American chisels and scissors, and they sell quite as readily as home-made. Then, again, German nails and small tools lead the market." He gives one crumb of comfort:—"Am glad to say that so far no foreigner has yet been able to oust Wheatman and Smith's large saws, Ward and Payne's sheep shears, Mathieson's augers, and Marples and Son's joiners' tools." Several of our agricultural implement makers, such as Richard Hornsby and Sons, Grantham, and Messrs. Spear and Jackson, Sheffield, have certainly recovered the trade in their specialities, and they have had a very good year. Messrs. Ward and Payne, at their new Limbrick Works, have added the manufacture of spades, shovels, picks, &c., to their other trades, and the stupidity which too long caused English makers to cling tenaciously to English patterns, instead of supplying what the colonists want, has long since been abandoned in favour of a more sensible and enterprising policy of doing business.

Mr. Frederick Brittain, one of the vice-presidents of the Chamber of Commerce, has been interesting himself in the establishment of a Customs' League for the whole of the British Empire. He has given notice that he intends to move the following resolution at the next meeting of the Council of the Sheffield Chamber of Commerce:—"That a memorial be presented to the Prime Minister praying that her Majesty's Government will invite to a conference to be held in London, properly accredited representatives from all her Majesty's colonies and dependencies for the purpose of considering the expediency of establishing a Zollverein or Customs' League, by means of which absolute free trade might be established between all parts of the British Empire; and further of considering upon what conditions the produce and manufactures of foreign nations should be admitted into the British Zollverein." Mr. Brittain, who is well known as an authority on all questions of foreign tariffs and commercial treaties, will further move that a copy of this resolution be sent to every Chamber of Commerce in the United Kingdom, and to the Colonial Institute, asking for their support.

The Danaby Main Company, when their hands ceased working, had 30,000 tons of steam coal in one stack. From that large bank men have been filling barges ever since, and it is now rapidly being lowered. Its disappearance will be welcomed by the men, who expect that the pits will then be re-opened to obtain more stack, and it cannot be distasteful for the owners to see this mass of unproductive fuel turned into cash.

The Ebbw Vale Steel, Iron, and Coal Company, whose capital is largely held in Manchester and Sheffield, is steadily buying up its debentures. The accounts of the trustees for the mortgagees and debenture-holders for the twelve months ending 31st December shows, after paying off debentures during the year amounting to £34,677 10s., a surplus balance in the hands of their bankers on that date of £50,802 4s. The total amount of debentures paid off by the trustees to date is £135,927 10s.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE Cleveland pig iron trade is still in a depressed and almost gloomy condition. The attendance at the market held at Middlesbrough on Tuesday last was better than it has been for some weeks past, but only a limited business was done. Prices were slightly more favourable to consumers than at the previous market. Most merchants are offering No. 3 g.m.b. for prompt delivery at 35s. 3d. per ton; for delivery to the end of June they ask 35s. 6d. to 35s. 9d. Some makers are accepting 35s. 9d. per ton for No. 3, for prompt delivery, but the majority still ask 36s., and will not accept less. Forge iron is in somewhat better request. Merchants' price is 33s. 9d. per ton, whilst makers continue to quote 34s.

Warrants are seldom mentioned. The nominal price is 35s. 6d. per ton.

The stock of pig iron in Messrs. Connal's store at Middlesbrough decreased 180 tons last week. At Glasgow their stock increased 52 tons.

Shipments of pig iron, from the Tees up to Monday night, were at about the same rate as in December. The quantity sent away was 25,366 tons this month, and 25,741 tons last month. Most of the iron exported is for Scotland.

The finished ironworks are in more regular operation now that the holidays are over. There is, however, great difficulty in getting in specifications sufficient to keep them running full time. There are a certain number of enquiries in the market, but the competition for them is exceedingly keen, and prices show no signs of improvement. Ship plates are offered at £5 per ton, bar iron at £5 2s. 6d., and angles at £4 15s., with usual extras for quality, all free on trucks at makers' works, less 2½ per cent. discount. Favourable specifications can be placed at somewhat less than the above figures.

The accountant's certificate, relating to the Cleveland blast furnacemen and miners' sliding scale, was issued on the 7th inst. It certifies that the net average invoice price of No. 3 Cleveland pig iron, for the three months ending December 31st, was 35s. 11·91d. per ton. Blast furnacemen's wages will therefore be reduced 1¼ per cent., and miners' wages about one-fourteenth of a penny per ton. The price of pig iron for the three months ending October 31st was 36s. 5·93d. per ton; the fall last quarter was therefore about 6d. per ton.

A meeting of Cleveland Ironmasters was held at Middlesbrough on Monday last, and the desirability of continuing the restrictive arrangement after the end of February was discussed. It is said that some of the masters are in favour of still further curtailing the output. Nothing definite was decided, but a committee was appointed to consider the matter further and report to a subsequent meeting.

At a meeting held at Sunderland on the 12th inst., the shipbuilders of the Tyne and Wear effected a settlement of the wages dispute previously existing between themselves and their men. The reductions agreed to are as follows:—Plating, 7½ per cent. all round; rivetting, 5 per cent.; caulkers on shell, 5 per cent.; other work in caulking, 7½ per cent.; angle iron smiths, 5 per cent.

Messrs. Raylton Dixon and Co., of Middlesbrough, have given their men notice that all wages on ironwork will be reduced 5 per cent. on and after the 19th inst.

Orders have been received by Messrs. Wigham, Richardson, and Co., of Walker-on-Tyne, for two small vessels, and by Messrs. Schlesinger, Davis, and Co., of Wallsend, for one vessel.

The value of goods exported from Middlesbrough during 1884—exclusive of coal and coke—was £2,247,122, being a decrease of £94,738 compared with 1883.

At the time of year when nights are longest and daylight soon over the inconvenience of imperfect systems of artificial lighting naturally forces itself upon public attention. Great as has been the improvement which the last few years have produced in the lighting of streets and open places, still the utmost success so attained has hitherto been far short of daylight even on the dullest day. Our streets are, however, now sufficiently well lighted to enable all the usual operations for which they exist to be carried on as well by night as by day. Traffic continues just the same, and nothing suffers. But there is one special sphere in which public lighting is still far from the best which could be done—where the ordinary occupations permitted by daylight cannot be continued without extreme difficulty after dark—and that is in railway carriages. When we reflect what a large number of persons is in railway trains any and every minute, by night as well as by day, it becomes evident that these should never be denied the opportunity of utilising their time, should they be so inclined, for want of light. It is true there are considerable difficulties in the way of reading and writing and other occupations in railway carriages; and that they are considered by many so nearly insuperable that idleness is practically the rule during railway travelling. Nevertheless there are many professional and other business men who are in the habit of employing their time profitably during travelling, and there are multitudes of others who desire to read and do read so long as daylight remains. But when it disappears all reading or other occupation is at an end because of the execrable lighting arrangements. There is, indeed, no real difference between the flat-wicked oil lamps generally used and those which were slung across the streets for dimly lighting them a hundred years ago before the advent of coal-gas. Even such little light as the smoky oil flame gives is interfered with by the brass wick holder situated exactly so that its shadow shall be cast downwards. The glass casing in which the lamp is contained assists, by inequality of thickness, to prevent the light from finding its way steadily to where it can be of most service. Gas lighting is, no doubt, an improvement on oil lamps for railway carriages; but it is far from such perfection as the public have a right to demand and expect. The experiments now in progress in the application of electric lighting to railway carriages are being watched in this district by many with great interest. It is perhaps too soon to pronounce whether the subsidiary rotating engine with dynamo placed on the locomotive, and supplying a current direct throughout the train, will be the chosen plan of the future or not, but it certainly looks very promising; and if combined with an accumulator for storage it will have a still better chance, for in that case the engine might be disconnected temporarily from the train for taking a new supply of water without involving extinction of all the lights. However that may be, the supersession of the present system of railway carriage illumination by a better one is imperatively necessary, and the gain thereby to many of the travelling public in utilisation of time will be so important as almost to count as a national benefit.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE has been rather more activity in the warrant market in the course of the past week, although the trade is yet very quiet. For shipping iron the inquiry has slightly improved, and so have the shipments, which in the past week were 7576 tons, against 4557 in the preceding week, and 9295 in the corresponding week of last year. There is again a small reduction of 47 tons for the week in the stock of pig iron in Messrs. Connal and Co.'s stores.

Business was done in the warrant market on Friday last at 42s. 3½d. cash. On Monday the market was quiet, with transactions at 42s. 2½d. to 42s. 4d. cash. Tuesday's market was a shade firmer, with business at 42s. 3d. cash. Business was done on Wednesday with a very flat market at 42s. 3d. to 42s. 2d. cash. To-day—Thursday—there was not much business done, but prices were a shade better, and the market closed with buyers at 42s. 4d. cash.

There is little change this week in the quotations of makers' iron, which are as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 52s. 3d.; No. 3, 47s. 3d.; Coltness, 56s. and 51s.; Langloan, 56s. 6d. and 51s. 6d.; Summerlee, 52s. 9d. and 47s.; Calder, 52s. 6d. and 47s.; Carnbroe, 49s. and 46s. 6d.; Clyde, 47s. and 43s.; Monkland, 43s. and 41s.; Quarter, 42s. 6d. and 40s. 6d.; Govan, at Broomielaw, 42s. 9d. and 40s. 9d.; Shotts, at Leith, 52s. 6d. and 51s. 3d.; Carron, at Grangemouth, 49s. (specially selected, 53s. 6d.) and 48s.; Kinneil, at Bo'ness, 45s. and 44s.; Glengarnock, at Ardrossan, 48s. 9d. and 43s.; Eglinton, 43s. 6d. and 40s. 3d.; Dalmellington, 47s. 6d. and 43s. 9d.

The manufactured iron trade is very quiet, but there is some expectation of an improvement in the demand for articles constructed of mild steel.

The contracts for the supply of the pig iron to be used in the Melbourne and Adelaide cast iron pipe contracts have now been arranged. Messrs. William Baird and Co., of Gartsherrie, are to supply the pigs for the Melbourne contract, which is one of 9000 tons. The order for the pigs for the Adelaide contract, which exceeds 12,000 tons of pipes, has gone to the Cleveland district. In both cases the pipes will be cast in the colonies.

The week's shipments of manufactured iron and steel goods from Glasgow embraced locomotive engines, valued at £8400, for Bombay; £4500 worth of machinery, of which £3500 went to Calcutta; £1930 rails, and £8680 sleepers, sheet and barge iron for the latter place; £6660 wagons, pipes, and tubes for Bombay; and £4110 pipes, tubes, and galvanised work for Melbourne.

The most reliable figures that can be obtained with reference to the shipping trade in Scotch coals during the past year give the total shipments at 3,685,285 tons, as compared with 3,659,613 in the preceding year, there being thus an increase in the present year of 25,672 tons. The current business in coals is comparatively good, but prices are difficult to maintain. From Glasgow the quantity despatched has been 22,578 tons; Greenock, 379 tons; Ayr, 3220; Irvine, 350; and Grangemouth, 4322 tons.

It was stated at the annual meeting of the Dalmeny Coal Company, held a few days ago in Edinburgh, that the requirements of the past year had rendered necessary the erection of 160 additional retorts, at a cost of £12,000. The chairman stated that even with the great competition in the oil trade, the company had been very prosperous during the year.

Business in the Clyde shipyards has now been fully resumed after the holidays. Several good orders have been received in the course of the past week, but many more are necessary before the trade can be in the position it occupied some eighteen months ago. The blacksmiths of the Glasgow district have appealed to the shipbuilders not to reduce their wages, as is proposed, on the 19th current, urging that they were only moderately paid in the busy times, and are therefore entitled now to the consideration of their employers. The shipwrights of Port Glasgow are also objecting to a reduction of wages, on the ground mainly that, although other towns are slack, theirs is well supplied with shipbuilding work.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE new gridiron of the Windsor Slipways Dry Docks and Engineering Company was opened this week, and a large steamer of Messrs. Cory's, 3300 tons burden, placed thereon. It is claimed by the company that there is accommodation for two vessels at the same time, or one up to the tonnage of 5000 tons, and that when the slipways, &c., are completed the works will be amongst the most important at Cardiff.

The promoters of old and new enterprise are getting more hopeful of late. A better tone is prevailing, and a steady increase of coal shipments in particular has taken place at each of the ports. Cardiff last week looked more like itself with a total of foreign shipments close upon 130,000 tons, and the lessened congestion on the sidings spoke well.

An important meeting of coalowners was held on Tuesday in Cardiff, when, in addition to the coalowners, the workmen's representatives of the sliding scale were present, and Mr. Thomas, manager of the Ynyshir Colliery, the place selected by the Home Secretary for shot test experiments. The chief subject discussed was the shot question, and the chairman proposed that a suggestion should be made to the Government that instead of pressing the rule for the withdrawal of the colliers during shot firing, a new rule should be instituted, directing the watering of the ground in the vicinity of the shot firing party when at work. After some conversation it was agreed to represent this view to the Home Secretary by a deputation.

It will be remembered in the district that the possibility of small coal-dust acting as a disseminator of an explosion over a large area has been long entertained and ably supported. Some time ago, if I am not mistaken, a tram was patented for watering coal mines.

The subject of an increase in the number of inspectors of coal mines is again to the front, and upon this subject also a deputation will wait upon the Home Secretary. A meeting of the Sliding Scale Committee has been held to consider the questions in dispute which caused the Gelli and Tynybedw strike. These were the standard cutting price and the pays. These questions were arranged in a satisfactory manner, the standard selected being that of the Monmouthshire and South Wales Coalowners' Association. It was stated at the meeting that the Cwmglo strike had been brought to a close, but that of the Merthyr Resolven Colliery is still waging. The only colliery property in the market as regards public announcement is the Milfraen, situated conveniently for the London and North-Western Railway, near Brynmawr. This will be brought to public auction early in February.

The Newport Dry Dock Company is about to construct another dock. The last report showed a flourishing state of things.

There is little to report in connection with iron and steel. Managerial changes are likely to occur in the district, of which due account will appear. Progress is making in the promotion of the Jenkins' Steel Works, Cardiff, though the times are not favourable to speculations in iron and steel. A start is expected in a few days at Cyfarthfa, and a good deal of interest is bent on the practical working of the new machinery. The rolling of the first steel rail will be watched with great attention. Dowlais is showing good work with its improvements—an encouraging sign to the men, who are led to hope that the company have a promise of good work from the colonies.

Taking the whole of the steelworks from Blaenavon to Landore there is a great lack of buoyancy. Whether an improvement will set in with the opening of the season remains to be seen. In the ordinary labour market wages are low, and what with this and short time, there is a good deal of distress in many places.

The working of the Rhymney and Great Western branch to the Cyfarthfa collieries is regarded as satisfactory, and Cyfarthfa coal for Cardiff is now sent by this route.

Tin-plate is not in good demand, and of late the patent fuel trade is slack. Foreign ore shows a slight improvement.

Steel bars are quoted for tin-plate at £5 12s. 6d.

An action is pending out of the rope-breaking accident at Treharris. It appears that two of the men were not members of the Miners' Provident Institution.

The ironworkers at Maisteg and Tondu have accepted the offered reduction of 10 per cent., and resumed work to the great gratification of the inhabitants of both places.

THE Bath and West of England Society and Southern Counties Association propose meeting at Bristol in 1886.

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.

6th January, 1885.

168. Lawn Tennis Court Marker, R. S. Moss, London.
169. Chair, J. H. Edwards, London.
170. Watering Streets, &c., A. L. Lineff and W. Jones, London.
171. Stoves, A. L. Coke, London.
172. Securing Castors to Chairs, &c., H. James and G. Robinson, Sheffield.
173. Preventing the Pilfering of Letters, &c., J. Watts, Manchester.
174. Hour Glasses, W. Belch, Greenwich.
175. Tool Box for Screw-cutting Lathe, J. and W. Shaw and T. Harrison, Bradford.
176. Drag Lever Brake, J. Chew and G. Parkington, Blackburn.
177. Facile Attachment, R. Crawford, Southsea.
178. Watches, &c., G. Williams, Birmingham.
179. Garnett or Saw Teeth, J. Hardy, Halifax.
180. Screw-cutting Lathe, J. and W. Shaw and T. Harrison, Bradford.
181. Making Helical Springs, L. Sterne, Glasgow.
182. Self-cleansing Steam Trap, R. Hargraves, Bolton.
183. Double Power Lever Brake, S. Houghton, Priestfield.
184. Self-closing Valve Taps, H. Ratcliffe, Pembury.
185. Producing Electricity, L. Mond, London.
186. Opening or Closing an Electric Circuit, H. Wilkinson.—(*J. G. W. Fairbairn, Vienna.*)
187. Potters' Seggars, Crucibles, &c., J. Gill, London.
188. Combined Holder and Reflector, &c., E. C. Toller, London.
189. Water Engine, &c., J. L. Lobley, London.
190. Fabrics for Covering Heated Surfaces, H. W. Johns, New York.
191. Opening Bottles, W. Edwin and C. Bailey, Brewood, near Parkridge.
192. Bolts, Nuts, and Joints, A. Requilé, London.
193. Removing Nap, &c., from Yarns, &c., W. Banks, London.
194. Absorbent Pad, E. M. Moore, London.
195. Condensing the Exhaust Steam of Tramway Engines, N. S. Russell, London.
196. Travelling Rugs, H. J. Haddan.—(*Handwerck and Petzoldt, Leipzig.*)
197. Braiding Machines, E. G. Brewer.—(*J. Andrew and T. F. Stevenson, United States.*)
198. Attaching Cord, &c., to Corks and Bungs, F. W. Russell, London.
199. Ball Castor, J. J. Frost, London.
200. Hanging the Rudders of Small Boats, A. T. Frampton, London.
201. Fire-escapes, J. H. Bowley, London.
202. Stoves, A. J. Boult.—(*K. Lerch and K. Seidl, Graz.*)
203. Dials for Watches, &c., J. Kendal and M. Laval, London.
204. Automatic Sights for Turret Guns, A. Noble and C. H. Murray, Newcastle-upon-Tyne.
205. Opening and Closing the Breech of Heavy Guns, C. H. Murray, Newcastle-upon-Tyne.
206. Carriages for Heavy Ordnance, W. J. Hoyle, Newcastle-upon-Tyne.
207. Blowing Engine, T. Nordenfelt, London.
208. Steam Generators, T. Nordenfelt, London.
209. Case Ammunition, T. Nordenfelt, London.
210. Torpedo Launches, T. Nordenfelt, London.
211. Treating Grain, A. W. Gillman and S. Spencer, London.
212. Carrier for Wood-turning Lathes, H. Salomo, London.
213. Securing Flanged Rails, W. Thomson, London.
214. Flushing Sewers, W. R. Lake.—(*H. C. Lowrie, United States.*)
215. Driving and Reversing Gear, W. R. Lake.—(*H. W. Fowler, U.S.*)
216. Drawing, &c., Corks of Bottles, &c., W. R. Lake.—(*Société Jacquier, Frères, Paris.*)
217. Wood Block Flooring, W. Court, London.
218. Production of Steel Gun Barrels, &c., Major Rose, Birmingham.—*3rd December*, 1884.

7th January, 1885.

219. Locks, &c., for Securing Bags, &c., J. B. Brooks and J. Holt, Birmingham.
220. Self-acting Double Grip Coupling for Railway Rolling Stock, J. Lees, New Zealand, and J. E. Lees, Oldham.
221. Cutting Screw Heads, M. and T. Kirby, Leeds.
222. Silent Tires for Road Vehicles, J. Macqueen, Longsight.
223. Compressing Green Crops for making Ensilage, T. Potter, Alresford.
224. Brake Blocks for Steam Tram Engines, &c., J. Inshaw, Aston, near Birmingham.
225. Unhairing, &c., Hides, &c., G. and J. Carver and J. Middleton, Halifax.
226. Type Writers, E. S. Belden, London.
227. Automatic Non-detaching Cut-off for Steam Engines, J. B. Pitchford and W. T. Garratt, London.
228. Wheels of Velocipedes, &c., T. Deane, London.
229. Unions, &c., for Connecting Metallic Pipes, &c., T. Birtwistle, London.
230. Street Orderly Bins, W. K. Sidgwick, Ilford.
231. Locks, B. Goulton, London.
232. Shirt Front, R. T. Jupp, Birmingham.
233. Fire Escape, T. L. Pulman, London.
234. Bottles and Stoppers for Same, G. A. and S. Spencer, London.
235. Tape Measures for Setting Out Lawn Tennis Courts, R. K. Messent, London.
236. Buttons, F. Ditterman.—(*Bennewitz Bros., Neustadt.*)
237. Paper-making Machines, J. Johnston and J. Fraser, London.
238. Disinfecting Rags, &c., in Bales, E. A. Cohen, London.
239. Treating and Disposing of Sewage, A. S. Jones, London.
240. Applying Turbines, &c., worked by Air, &c., to Utilise the Head Pressure, G. M. Capell, London.
241. Desiccated Cocoanut, E. B. Hambley.—(*W. T. Linton, United States.*)
242. Marking the Position of Sunken Vessels, &c., H. J. Haddan.—(*A. Titoff, J. Muirhead, and F. Riches, St. Petersburg.*)
243. Petroleum Cooking Apparatus, H. J. Haddan.—(*R. Richter, Leipzig.*)
244. Envelopes, J. J. Coleman, London.
245. Automatic Gear Cutting Machines, &c., A. H. Brainard, London.
246. Combined Box and Drawer, E. D. Grose and R. I. Barnes, London.
247. Fire-lighters, J. Maynes, London.
248. Spectacles, Eye Glasses, and Folders, G. Culver, London.
249. Candle Support, W. Lane, London.
250. Basic Cinder, J. M. H. Munro, Salisbury, and T. Wrightson, Stockton-on-Tees.
251. Fastening Buttons, W. R. Lake.—(*A. G. Wilkins and J. B. Miller, U.S.*)
252. Constructing, &c., Electrical Machines, J. S Williams, Riverton, U.S.
253. Constructing, &c., Electrical Machines, J. S. Williams, Riverton, U. S.
254. Constructing, &c., Electrical Machines, J. S. Williams, Riverton, U.S.

8th January, 1885.

255. Window Fasteners, T. Thornton, Bury.
256. Granulated Soap, E. Wilson, Exeter.
257. Stoppering Bottles, H. Finch, Manchester.
258. Conveying and Burning Gas in Connection with Gas Furnaces of Steam Generators, J. Jackson, Liverpool.
259. Treating Vat Liquor, T. D. Owen, Egremont.
260. Tooth Wheels, J. Mallol, Birmingham.
261. Boiling Water by Gas, J. Warburton, Conisburgh.
262. Wheels, I. Whitehouse, Birmingham.
263. Casks or Barrels, E. G. Leroy, Manchester.
264. Door Fastenings, J. Walker, Birmingham.
265. Syruping, &c., Aerated Waters, J. Lyon and T. Critchley, Liverpool.
266. Skates, A. H. Boultbee, London.
267. Elevated Tram-car Train and Railway, D. Ellis, Aberystwith.
268. Gas Burners, J. J. Royle, London.
269. Diminishing Mechanical Friction, E. Toynbee and I. R. Culley, Willesden.
270. Tricycles, &c., A. Santer, London.
271. Watches or Clocks for Denoting the Day of 24 Hours, L. H. Borrel, London.
272. Beer, &c., Taps or Valves, H. Trott, London.
273. Combing Wool, &c., J. C. Walker, London.
274. Cleansing, &c., Oils or Grease, B. Rhodes, London.
275. Drying Colouring Paste, &c., E. Passbury, London.
276. Telephonic Apparatus, A. P. Price, London.
277. Repeating Mechanism for Breech-loaders, A. J. Boult.—(*Count R. de Montgelas, Egglkofen.*)
278. Turning, &c., Rifling Ordnance, A. Greenwood, London.
279. Finishing Ordnance, A. Greenwood, London.
280. Lamp Protectors or Lanterns, J. B. Barnett, London.
281. Clearing Tramway Lines of Snow, I. F. Cuttler, London.
282. Electric Telegraphy, A. M. Clark.—(*L. Maiche, Paris.*)
283. Stoppers for Bottles, G. F. Redfern.—(*A. B. Vanes, Cape of Good Hope.*)
284. Boots and Shoes, S. F. Feldman, London.
285. Adapting Fire-arms for Miniature Ammunition, R. Morris, London.
286. Valve Gear for Steam Engines, C. Hartung, London.
287. Compound Metal Plates, C. D. Abel.—(*Dillinger Hüttenwerke, Dillingen-on-the-Saar.*)
288. Guns, H. S. Maxim, London.

9th January, 1885.

289. Life Rescue Belt for Skaters, &c., J. S. Comrie, London.
290. Raising, &c., Water by Atmospheric Pressure, &c., R. G. Laird, Nuneaton, C. Matcham, Horsham, and P. H. Evans, Bredon.
291. Watches, &c., R. H. Ellacott, Plymouth.
292. Leg Guards, J. Vickers, London.
293. Clocks, &c., W. Morris, London.
294. Trimming the Heels of Boots and Shoes, R. H. Southall, Headingley.
295. Regulating the Speed of Engines, W. D. and S. Priestman, London.
296. Cricket Boots and Shoes, W. Garrood, Northampton.
297. Balanced Slide Valves, W. Rowntree and G. Temple, Liverpool.
298. Removing Scum from Steam Boilers, T Elcoate, Liverpool.
299. Receptacles for Growing Plants in, J. Cowan, Liverpool.
300. Wires for Pianofortes, &c., C. Hassel, Liverpool.
301. Governors of Steam or Compressed Air Engines H. W. Pendred, Streatham.
302. Self-acting Single-chain Grab, G. T. Peters, Bath.
303. Indicating Temperature or Pressure, J. Murrie, Glasgow.
304. Crushing Stone, &c., J. Foulds and S. Tomlinson, Bradford.
305. Walking-stick Life-saving Apparatus, W. Burton, Sunderland.
306. Diminishing the Rolling of Ships at Sea, A. Cameron, Glasgow.
307. Rope Couplings for Railway Vehicles, R. C. Sayer, Newport.
308. Lifting Jacks, W. P. Thompson.—(*F. Westmeyer, St. Johann-on-Saar.*)
309. Supply Valve for Water-closets, A. Emanuel, London.
310. Fastenings for Shoes, H. A. Done, Birmingham.
311. Electric Telegraph Apparatus, J. S. Gisborne, London.
312. Preservative Composition or Paint, J. S. Gisborne, London.
313. Bait Can for Fishing, G. B. Read, London.
314. Junction Parts of Trowels, Spades, &c., J. Leo, Birmingham.
315. Valve Operating Apparatus for Mining Machines, S. Stutz, London.—*2nd October*, 1884.
316. Mining Machines, S. Stutz, London.—*5th August*, 1884.
317. Reservoir Lamps, C. Barton, London.
318. Fishing Reels and Rods, A. J. Boult.—(*R. Neyle, Newfoundland.*)
319. Filters, J. W. Ingham, London.
320. Alarm Clocks, A. W. L. Reddie.—(*The Assonia Clock Company, United States.*)
321. Rendering Luminous Marine and other Compasses, W. C. Horne, London.
322. Tennis Balls, J. Neville, London.
323. Vessels for Containing Milk, &c., J. C. Mewburn.—(*L. Passot, Paris.*)
324. Kitchin Ranges and Cooking Stoves, W. Stobbs, London.
325. Setting Out Curves, W. H. Beck.—(*L. Capazza and P. Livrelli, Paris.*)
326. Filling Bottles with Flavoured Beverages, N. G. Wilcocks, N. St. G. Wilcocks, and A. Stockall, London.
327. Points or Crossings for Railway Lines, L. Vojacek, London.
328. Adjusting the Suspending Cords of Blinds, R. W. Scaife, London.
329. Bottle-stoppers, J. N. Aronson and C. B. Harness, London.
330. Screw Bolt, H. H. Lake.—(*J. Patten, jun., U.S.*)
331. Latch, M. P. Ismay, London.
332. Bolt Cloth Tighteners, C. A. Smith, London.
333. Wardrobe, &c., W. Heelis, London.

10th January, 1885.

334. Artificial Flowers, E. Vagner and F. Mitchell, London.
335. Boring Machines, R. Stanley, Nuneaton.
336. Utilising the Exhaust Steam of Non-condensing Engines, H. J Sloman, Northampton.
337. Driving the Spindles of Spinning Machines, J. W. Dawson and H. Simpson, Manchester.
338. Safety Pins, H. W. Tonks, Birmingham.
339. Heating, Cooling, and Ventilating, J. G. Lorrain, London.
340. Faced or Coated Bricks, R. A. Rossborough, Liverpool.
341. Heating the Contents of Feeding Bottles, &c., L. White, Chorlton-cum-Hardy.

342. VELOCIPEDES, E. K. Dutton, Cheadle Hulme.
343. EYELET or STUD for BOOTS, J. Hall, Halifax.
344. BOOT and SHOE CLEANING MACHINE, J. Griffin, Marlborough.
345. HOLDERS for EVER-POINTED PENCILS, J. Appleby, Birmingham.
346. PRINTING and DYEING COTTON FABRICS, &c., F. A. Gatty, Manchester.
347. RENDERING WICKERWORK BASKETS WATERPROOF, A. J. Gillespie, Glasgow.
348. PUNCHING HOLES in GLASS BOTTLES, D. Rylands, Barnsley.
349. STOPPERS for BOTTLES, &c., R. W. Little, Manchester.
350. SUPPLYING WATER to PLANTS, &c., W. H. Phillips, Weston, near Bath.
351. PRODUCING MECHANICAL FEED MOTIONS, &c., G. R. Postlethwaite, Birmingham.
352. TRANSMITTING POWER for SEWING, &c., MACHINES, G. R. Postlethwaite, Birmingham.
353. CUTTING or REDUCING SUGAR CANES, &c., A. Cook, Glasgow.
354. COMBINED MAGNETS and COILS, &c., J. Scotland, Glasgow.
355. FIRE-ESCAPES and ASCENDORS, J. E. Walsh.—(*E. Frisou, Malines.*)
356. TOY, G. G. M. Hardingham.—(*J. N. Lützelberger, Sonneberg.*)
357. OIL CANS, J. Chapman, London.
358. PISTONS for STEAM ENGINES, J. Tweedy and J. Patterson, London.
359. HEATING FEED-WATER of MARINE BOILERS, &c., J. Tweedy, London.
360. CUFF or WRISTBAND, A. H. Storey, London.
361. OPENING BOTTLES, J. T. Creasey and A. T. J. Wild, jun., London.
362. APPARATUS for CLEANING BOOTS, &c., J. O. Spong, London.
363. BAKERS' OVENS, A. W. L. Reddie.—(*C. T. Seidel, Dresden.*)
364. METALLIC POCKET KNIVES, H. Hewitt, London.
365. METALLIC BEDSTEADS, &c., A. H. Griffiths and E. Smallwood, London.
366. BOBBINS or SPOOLS, J. Holmes and A. Holmes, Halifax.
367. PREPARATION of SAFETY PAPER, J. Jameson, London.
368. GUNPOWDER, F. B. W. Roberts.—(*F. Becker, Hamburg.*)
369. DETECTING ESCAPE of INFLAMMABLE GAS, J. Imray.—(*E. Arnould, Paris.*)
370. CARS, E. Schultze, London.
371. WOVEN LOOPED FABRICS, H. H. Lake.—(*L. Cordonnier, Roubaix.*)
372. MECHANICAL TOYS, H. H. Lake.—(*W. H. Anderson, U.S.*)—1*st July*, 1884.
373. EXCAVATORS, H. H. Lake.—(*H. Hartmann, Mannheim.*)
374. MECHANICAL PLAYING of PIANOFORTES, &c., A. P. Hodgson, London.
375. MANUFACTURING TOOLS, A. M. Clark.—(*F. Southgate, Paris.*)
376. ELECTRIC ANNUNCIATOR, F. Walker, London.
377. BOTTLE STOPPERS, I. R. Sharpe, London.
378. LOOMS for WEAVING DOUBLE CLOTH, T. Hollings and W. Hall, London.

12th January, 1885.

379. HINGE for ATTACHING RUDDERS to BOATS, E. Kent, London.
380. CORRUGATED FURNACE SHELLS, &c., J. Haythorn, Glasgow.
381. UTILISING ALKALI WASTE, E. W. Parnell and J. Simpson, Liverpool.
382. PANELLING and PRESSING BRICKS, J. W. Snowdon and S. R. Swallow, Leeds.
383. SPINNING and DOUBLING COTTON, &c., T. Ashworth, Manchester.
384. FASTENING WINDOWS and CASEMENTS, F. R. Silk, Birmingham.
385. DIALS for CLOCKS, WATCHES, &c., J. Birkett, Keswick.
386. REPRODUCING ORNAMENTAL DESIGNS, J. Bryce, Glasgow.
387. COMBINATION PLIERS, J. Lucas and C. Hall, Birmingham.
388. SELF-CLOSING DOORS and GATES, T. Softley, Gateshead.
389. PREVENTING the OVERSLIDING of DRAWERS, &c., D. H. Dickinson, Newcastle-upon-Tyne.
390. BUILDING BRICKS, F. J. Kellow, Southampton.
391. SMOKING APPARATUS APPLICABLE to CIGARS, &c., C. Jackson, Nottingham.
392. GENERATING of PRESSURE, &c., P. Smith, R. Wild, and H. Ledger, Rusholme.
393. MULTIPLICATE BRACKET, J. Stone, Birmingham.
394. COUPLING RAILWAY CARRIAGES, &c., J. Farrer, London.
395. BALANCING the TOP RAIL of ROVING and SLUBBING FRAMES, S. Tweedale, Halifax.
396. CARDING ENGINES for CARDING COTTON, &c., S. Tweedale, Halifax.
397. LIQUID METER, E. Tatham, Liverpool.
398. APPLYING CENTRE-BOARDS to BOATS, W. H. Biffen, Liverpool.
399. WATERPROOFING, &c., BOOTS, J. H. Davies.—(*J. B. Dupret, Brussels.*)
400. MOUTHPIECES and DIES to be used in the MANUFACTURE of CLAY BRICKS, &c., A. Andrew, London.
401. BOTTLE STOPPERS or CAPS, B. Weldon, Birmingham.
402. BOTTLE STOPPERS, B. Weldon, Birmingham.
403. WATER FILTERS, H. Harris, London.
404. GLASS, &c., JARS, E. Johnson. London.
405. FIXING ADJUSTABLE STEPS, &c., of VELOCIPEDES, A. Peddie, London.
406. LAYING NATURAL ROCK PAVEMENTS, M. Macleod, Deansgate.
407. DIALS of WATCHES, &c., C. Ankers, London.
408. PRODUCING TANNING, &c., MATERIALS, T. Cobley, London.
409. BEE-HIVES, C. G. Mason and A. Buchan, London.
410. GRIP WHEEL and BED, W. Wilkinson, Kempston.
411. INLAYING GLASS in GOLD and SILVER, &c., C. Norton, London.
412. WATCHES, &c., S. Waters, London.
413. BAROMETER, J. D. Young, London.
414. PREVENTING WASTE of WATER, J. T. Julian and T. E. Phillips, London.
415. SAFETY LOCKING APPARATUS for the WHEELS of PERAMBULATORS, J. Hoghton, London.
416. ATTACHING INDIA-RUBBER PIPES to METAL UNIONS, J. H. Wild, London.
417. WATCHES and CLOCKS, C. W. Lund, London.
418. REGULATING BALANCE SPRINGS of TIMEPIECES, A. Junghans, London.
419. COAL GAS, &c., F. Leslie and J. A. Wanklyn, London.
420. CLOCKS and WATCHES, R. Vigier.—(*J. P. A. Schlaefli, Soleure.*)
421. AUTOMATIC SELF-CLOSING VALVE or TAP, S. A. Johnson, London.
422. HORSESHOES, T. Nugent, Walthamstow.—16*th January*, 1885.
423. PRODUCING HEAT, C. R. Schomburg, London.
424. COATING GLASS, &c., with LIQUIDS, A. L. Henderson, London.
425. STAIRCASE, W. J. Wegner, London.

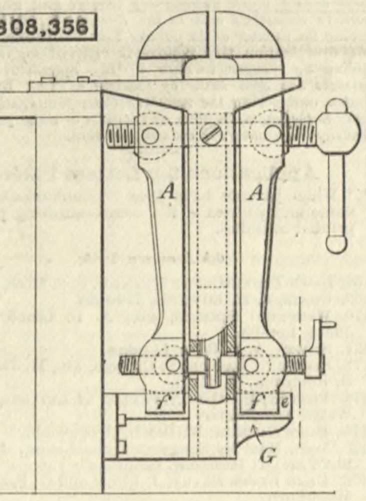
SELECTED AMERICAN PATENTS.

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

308,356. TOOL FOR GRASPING AND HOLDING ARTICLES, *Jos. Goodrich, Henry, Ill.—Filed May 19th*, 1884.

Claim.—A tool for grasping and holding articles, having jaws provided with spherical recesses to receive the nuts for the screws, and spherical nuts made to fit into said recesses, bored diametrically to receive the screws, and secured in their places by the means substantially as set forth—that is to say, portions of the convex surfaces of the nuts are cut away on opposite sides, and portions of the lateral faces of the jaws set into the recesses thus formed—as described. As a means of preventing the torsions of the jaws A of the tool, and also for relieving the strain on the tail screw, the tail piece G, connected rigidly with the

308,356

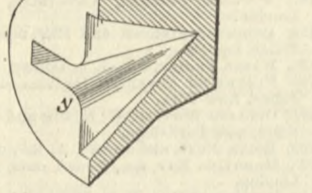


stock or part in which the tail screw is mounted, and provided with a laterally flanged bearing e, and the jaw provided with cross slots to engage said bearing, and with lugs f to take under the projecting flanges of the same, substantially as set forth.

308,246. SCREW, *John Frearson, Birmingham, county of Warwick, England.—Filed December 7th*, 1883.

Claim.—A screw or screw blank in the head of which is an orifice formed by nicks with tapering ends and

308,246

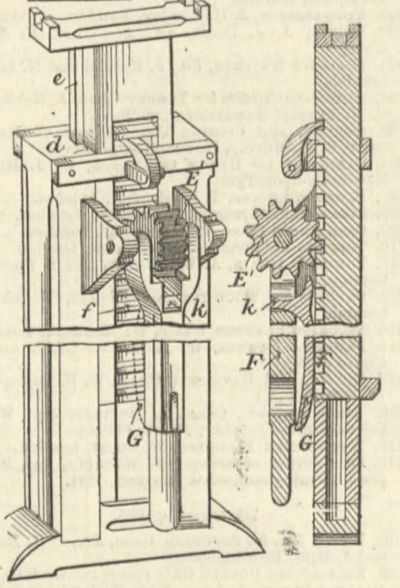


sides converging toward a point, said orifice having rounded corners y, where the nicks join each other, as set forth.

308,361. LIFTING JACK, *Joseph S. Hood, Stahlstown, Pa.—Filed October 1st*, 1884.

Claim.—In a lifting jack, the combination, with the supporting frame having grooves d, as shown, of a sliding rack bar having tongues e and teeth f, a gear

308,361

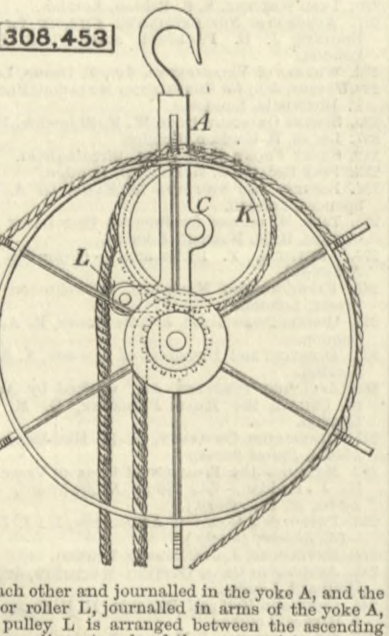


wheel E^1, a handle F, lever G, having lug k, a pawl, and a spring to hold said pawl in engagement with the teeth of the rack bar, substantially as set forth.

308,453. HOISTING GEAR, *William W. Wythe, Ocean Grove, N.J.—Filed February 2nd*, 1884.

Claim.—(1) In a rope gear, the combination, with the yoke A, of the gear wheel J and the grooved rope pulley K, united or made integral and journalled in the yoke A, the gear wheel C and the pulley D, united

308,453

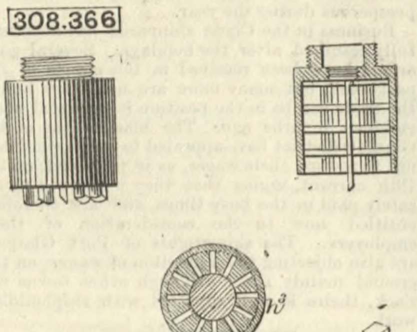


with each other and journalled in the yoke A, and the pulley or roller L, journalled in arms of the yoke A, which pulley L is arranged between the ascending and descending strands of the rope and is not connected with either of the gear wheels, substantially as herein shown and described. (2) In a hoisting gear, the combination, with a yoke, of a united pulley and pinion journalled in the lower end of the same, a united pulley and gear wheel journalled in the joke above the pinion and pulley, the gear wheel and pinion engaging, and a roller journalled in the yoke and arranged between ascending and descending strands of the rope passing over the pulley united with the pinion and around the pulley united with the gear wheel, which roller is entirely independent of either of the gear wheels, substantially as herein shown and described.

308,366. ROTARY CUTTER HEAD FOR STONE DRESSING MACHINES, *James W. Maloy, Somerville, Mass.—Filed May 22nd*, 1884.

Claim.—(1) In a stone dressing machine, a rotary hollow cylindrical holder having internal radial slots and internal annular slots in its inner surface crossing each other, for receiving the tools and projections thereon, as set forth. (2) In a stone dressing machine,

308.366

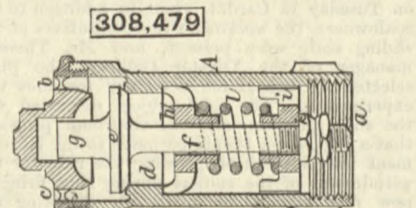


a rotary cutter composed of a hollow cylindrical holder having internal radial slots and internal annular slots intersecting said radial slots, one or more bits having their shanks inserted in the radial slots, and bent ends inserted in the annular slots, and a plug h^3 detachably secured to the interior of the holder and bearing against the inner edges of the bits, as set forth.

308,479. SAFETY VALVE, *Theodor Falk and Alexander Frazier, Maywood, Ill.—Filed May 22nd*, 1884.

Claim.—(1) In a safety valve, the combination, with the body A, provided with the valve seat d, the valve e, provided with the stem f and guide g, the bridges h i, spring l, and nuts k, of the cap b, recessed to receive the guide g, and provided with the opening c, substantially as herein shown and described. (2) In

308,479

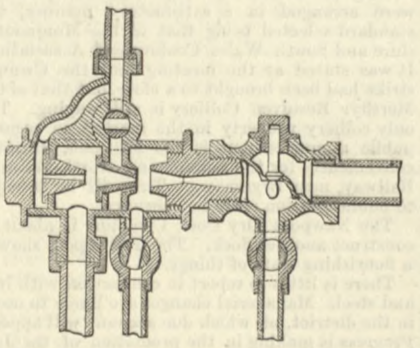


a safety valve, the combination, with the body A and its valve e, provided with the guide g, of the cap b, recessed to receive the said guide, and provided with the openings c, and the groove m beneath the said openings, substantially as herein shown and described, and for the purpose set forth.

308,507. STEAM BOILER INJECTOR, *Francis B. Maxwell, Jackson, Mich.—Filed January 9th*, 1884.

Claim.—An ejector, the combination, with the casing, of a lifting jet nozzle, a combining tube, a water chamber situated between said nozzle and tube, a delivery tube, and an annular supplemental or force

308.507

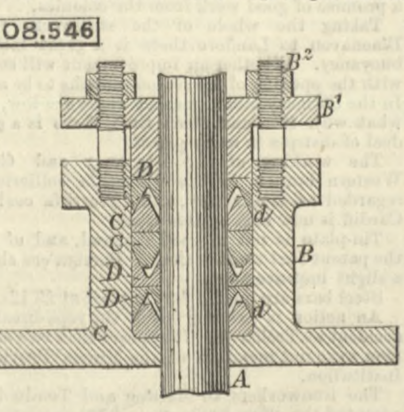


jet orifice situated between the combining tube and the delivery tube, and concentric with the former, the delivery end of the lifting jet nozzle terminating in said chamber outside the combining tube, substantially as set forth.

308,546. METALLIC PACKING, *Samuel Armstrong, Newark, N.J.—Filed March 22nd*, 1884.

Claim.—(1) The metallic packing constructed, as herein shown and described, with two rings C and D, the ring C being formed with a wedge-shaped annular

308.546

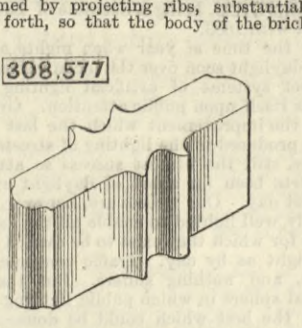


projection c, and the other with an annular wedge-shaped groove d, of smaller radius than the opposed projection, the rings being cut and pressed together when in use, substantially as shown and described. (2) The combination, in a metallic packing, of the series of rings C and D, constructed with external flat surfaces and internal wedge-shaped grooves and projections described, and arranged in the stuffing box with the flat surfaces of the same kind of ring in contact, as and for the purpose set forth.

308,577. BRICK FOR REGENERATIVE FURNACES, *Samuel A. Richards, Joliet, Ill.—Filed April 24th*, 1884.

Claim.—(1) A brick having a tongue at each end and a corresponding groove across each side, the grooves being formed by projecting ribs, substantially as before set forth, so that the body of the brick is of

308.577

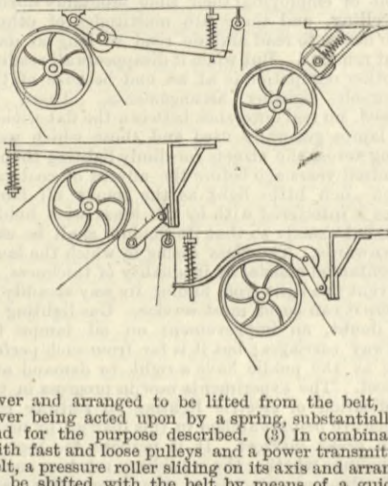


substantially uniform thickness throughout. (2) brick having a tongue at each end and a corresponding groove across each side, the grooves being formed by projecting ribs, which are joined on the exterior to the sides of the brick by a concave filling, substantially as before set forth.

308,588. DEVICE FOR TRANSMITTING POWER BY BELTS AND PULLEYS, *Nicholas Yagn, St. Petersburg, Russia.—Filed June 27th*, 1884.

Claim.—(1) In combination with the power transmitting pulley and belt, a pressure roller arranged on a crank lever and pressing the belt against the pulley by the action of a spring applied to the longer arm of the crank lever, substantially as shown and described. (2) In combination with the power transmitting pulley and belt, a pressure roller pivotted to a crank

308.588



lever and arranged to be lifted from the belt, said lever being acted upon by a spring, substantially as and for the purpose described. (3) In combination with fast and loose pulleys and a power transmitting belt, a pressure roller sliding on its axis and arranged to be shifted with the belt by means of a guiding fork, substantially as described and shown. (4) In combination with the fast and loose pulleys and a power transmitting belt, a pressure roller of double the width of each of the pulleys, substantially as described and shown.

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