ROYAL AGRICULTURAL SOCIETY'S TRIALS OF SHEAF-BINDERS.

It is seldom that so painstaking and searching a trial of implements has taken place under the auspices of the Royal Agricultural Society of England as that of sheaf-binding machinery, which commenced on Wednesday in last week in the neighbourhood of Shrewsbury. Looking back upon the contest in its entirety, we are bound to confess that the arrangements were well planned; but, granting this, it must at the same time be admitted that in one or two instances the exercise of greater foresight would have been the means of saving no inconsiderable amount of time, both to the competitors and to the public. In a degree such a criticism would apply to most plans, but it is strongly felt that a great Society like the Royal, when it does decide upon testing thoroughly the relative merits of any class of agricultural machinery, may reasonably be expected to give full consideration to the detailed requirements of such a trial, and so to order matters as to avoid the possibility of delay or unnecessary prolongation. To take a single instance—on Tuesday nothing was done until half-past one in the afternoon beyond the testing of two or three machines on the dynamometer. This work required only the supervision of the engineers, leaving the judges and stewards free to proceed with the appointed further trials on barley. But these trials had to be postponed four or five hours simply because nobody seemed to have given directions for the avenues to be cut out in readiness for a start. We simply mention this as one illustration of the way in which valuable time was wasted. A minor criticism is that in the official announcements not a word was said about trials at Montford, although, as a matter of fact, they all took place there with the exception of the preliminary portion in a field of seventeen acres of oats at Dinthill, the only place advertised by the Society. Probably few people have been inconvenienced, as events turned out, yet that does not excuse the Society from blame. Nothing could have been simpler than to correctly indicate to intending visitors after Wednesday the place fixed upon for the field trial, whereas the two places, Dinthill and Montford, are a considerable distance apart.

In previous issues of The Engineer we have outlined the main facts respecting the Royal Agricultural Society's trials of sheaf-binding machinery—at Liverpool in 1877, Bristol in 1878, and Derby in 1881—as well as recorded the regulations and other details appertaining to this year's contest; and therefore all that need now be done is to remind the reader that although thirty-one machines were originally entered for competition—twenty-eight in Class 1 and three in Class 2—only eighteen were included in the Shrewsbury Showyard last month, the remaining number consequently becoming ineligible for competition. Class 1, it should here be stated, was for sheaf-binding reapers, with a first prize of £100 and a second of £50, the other class being for separate sheaf-binders; prize, £25. In both instances an essential condition is set forth that the binding material should be "other than wire," and it may at once be mentioned that string is the material adopted by every competitor. A noteworthy feature of the whole of the four sheaf-binding trials instituted by the Royal Agricultural Society consists of the fact that they have been to a large extent American *versus* English competitions. On the first two occasions all the honours went across the Atlantic, while at Derby, three years ago, the gold medal was also carried off by an American firm, an English and an American house at the same time receiving a silver medal apiece. This time it will be satisfactory to home manufacturers to learn that the decision of the judges reverses previous results by keeping both of the prizes awarded in our own country. Another crushing defeat would have been little short of a disgrace to the reputation of English agricultural engineers, after the large amount of enterprise and skill which, as is well known, have been during recent years devoted to the binder trade. Happily their efforts have been at length rewarded. After watching the contest from day to day, we are convinced that the prizes are thoroughly well deserved by those upon whom they are bestowed. Not a breath as to the existence of favouritism reached our ears. Even the most disappointed competitor must admit that he has been fairly beaten. Nothing could have been more praiseworthy than the manner in which judges and stewards alike assiduously devoted themselves to an arduous task, diligently toiling round each plot after the competing machines, under a burning sun, for more than six long days, and making copious notes of the several performances. Their unflagging zeal was a subject of common remark. The judges, it may be noted, were: Mr. Thomas Bell, Hedley Hall, Newcastle-on-Tyne; Mr. Mason Cooke, The Lawns, Ely, Cambs; Mr. William Scotson, Mossley Hill, Liverpool. Sir John Thorold was on duty as a steward from beginning to end. On the first two days, the Honourable Cecil T. Parker acted in a similar capacity, after which he was relieved by Lord Moreton, M.P. During a portion of the time, assistance was also rendered by Mr. J. Bowen-Jones, while the post of assistant steward was filled by Mr. E. L. Box. Mr. F. S. Courtney acted as engineering superintendent, and Mr. W. Anderson, the Society's engineer, was present on the last three days, when the dynamometer trials were made. Mr. H. M. Jenkins, who was on the ground, did not take a very prominent part in the proceedings. A small detachment of the local police found exceedingly little to do in the direction of preserving order, because, with the exception of the first two days, visitors other than those immediately concerned in the competition were few and far between. A very limited number of farmers visited the ground, a circumstance which can only be explained by the fact that sheaf-binding reapers have ceased to be a novelty, and that harvest operations are now in full swing.

At the close of the Shrewsbury Show the exhibitors were permitted to regain possession of the machines entered for competition in consideration of a deposit of £25 for each binder, as a guarantee for its production on the trial field in proper condition at the time appointed. For all practicable purposes this stipulation was adhered to by every exhibitor except one—Mr. A. C. Bamlett, of Thirsk—the absence of whose machine is attributed to the unsuccessful issue of certain improvements which he was anxious to introduce. His deposit is, therefore, forfeited. Mr. George Kearsley, of Ripon, had two binders entered for trial, but one of them did not arrive at the field until shortly after the required hour on Wednesday morning, and it was consequently not admitted. In this instance, however, the fine was not enforced. Thus the actual competition in Class 1 became restricted to sixteen implements, viz.:—English, ten: Hornsby and Sons, 3; J. and F. Howard, 3; Samuelson and Co., 2; George Kearsley, 1; H. J. H. King, 1. American, six: Lankester and Co.—agents for McCormick Harvesting Company—3; Walter A. Wood, 2; Johnston Harvester Company, 1.

The competitors in Class 2 were Messrs. Kingsford, Fairless, and Co., with two machines, and the Notts Fork and Implement Company, with one.

The field selected for the first day's trial consisted of 17½ acres of black oats on land at Dinthill, four miles from Shrewsbury, in the occupation of Mr. Edmund Hawkins. This field had been duly staked out into plots of three-quarters of an acre each, and after drawing lots for the different portions, operations were at once commenced, the odd numbers being first taken. Messrs. Hornsby and Sons started work with their new string binding harvester, which got through the allotted portion with great credit, picking up almost every straw and throwing off well-bound sheaves of fair size. Later in the day the same firm showed their "1884" string binding harvester, which did its work pretty much in the same fashion, leaving a clean stubble. Messrs. Hornsby's third machine, which was also set in motion, made good progress. Messrs. J. and F. Howard's machines appeared to us to show off their capabilities about as advantageously as those turned out from the Grantham Works. The binders from Bedford all seemed to be well under the management of the driver, who, like most of the men occupying corresponding positions, was evidently selected with judgment. In a word, the three machines did very satisfactory work. The binder belonging to Messrs. Samuelson and Co., of Banbury, which won a silver medal at Derby, gave evidence of good qualities, which, by the way, were apparent all through the competition. Mr. George Kearsley went over his plot in very quick time without a hitch, beyond missing one sheaf. Mr. King's machine was less successful, and the judges were not slow to mark their disapprobation of its somewhat slovenly work by declining to allow it to operate on succeeding days. On the whole, the three McCormick machines performed their work creditably, and the two shown by Mr. Walter A. Wood did likewise. Unfortunately, however, the exhibit of the Johnston Harvester Company—who ranked equally with Samuelson and Co. at Derby—made but poor work, in consequence of which, to the disappointment of many, it was ruled out of the competition.

The next morning—Thursday—a trial was made with the separate binders. The proceedings, however, came to a speedy and abrupt termination, for the sufficient reason that the competing inventions proved utterly incapable of doing the work expected of them. A large amount of money has, we understand, been expended by the competitors in endeavouring to perfect their machines, and on that ground at least the failure is sincerely to be regretted. On the other hand, it is a question whether, in the future, there will be a sufficient demand for this class of agricultural machinery to justify the investment of a large sum. After the breakdown of this portion of the trials an adjournment was made to Montford, where, on the farms of Mr. T. S. Minton and Messrs. Lee, the remainder of the trials of sheaf-binding reapers took place. The land lay comparatively close together. Nineteen acres of white oats, divided into one-acre plots, were straightway commenced upon. The crop was not so easy to deal with as that of the previous day, the tangled condition of the straw causing frequent stoppages to get rid of chokings. Three or four of the plots were especially bad, the ground being very uneven. Still, altogether the work was nicely done. For the second time, Mr. Kearsley did remarkably rapid work, clearing his acre in thirty-three minutes, though it is to be feared that he made the mistake of sacrificing efficiency to speed. Hornsby's new 1884 binder, which took eight minutes longer to go over the same area, gave a much better result; while the Wood and McCormick machines occupied respectively ¼ minute and ½ minute more than Hornsby. All these machines stood pretty high, as also did Samuelson's prize binder. Their low-delivery machine, which dispenses with the usual elevators, running the grain on to a metal platform at a very slight elevation from the knives, and delivering the sheaves between the binding apparatus and the driving wheel, did not give a large measure of satisfaction. Reviewing the whole day's work, the general impression was in favour of Howard, Hornsby, McCormick, and Samuelson. One of Wood's machines, too, did some creditable work.

On Friday eight machines were at work in a 43-acre field of wheat, 2 acres being given to each binder. In the morning, Wood, Hornsby, McCormick, and Howard all made good performances in their way. Howard turned out some splendid sheaves at regular intervals, accomplishing the allotted piece in 1 hour 19½ minutes, this being the quickest work done during the day. As to time, Hornsby was eight minutes behind, and the character of the work bore favourable comparison. Wood got through nicely, and McCormick, though slower, made a good stand. The afternoon's work by Hornsby, McCormick, and Howard had many points of merit, and the day's proceedings were ended by an unfortunate breakdown to Samuelson's low delivery, due to the breakage of a small casting.

Regarding Saturday's work not much need be said. Only the remaining six machines were got to work, each on 2 acres of the same wheat, the time varying from 1 hour 23 minutes, with Howard's No. 47 machine, to 1 hour 54 minutes, with Samuelson's. Altogether, Wood and Howard seemed to show off to greatest advantage this day, although Samuelson's threw off good sheaves.

Samuelson and Co. having again got their low-delivery machine in working condition, and were allowed to finish their plot in the course of the day—Saturday. It did not pick up all the straw, and an unusually large quantity of grain was left on the ground. The machine, according to the general verdict, will need a large amount of transformation ere it will be entitled to rank as a success. In principle there is much to commend it, but between principle and practice there is a wide divergence. The same binder was also for some reason—probably on account of its novelty—permitted to work again on Monday in the barley field, though it was understood to be no longer in the competition. Therefore, although fourteen plots were marked out, and operated upon, on Monday, by this time the contest lay between thirteen machines. For this day the arrangements were to work all these binders, each on two acres of barley, very short in the straw—although eight machines sufficed for Friday and six for Saturday—a programme which was well adhered to. It had also been notified that such machines as should be selected to go on the dynamometer were to proceed at once to a 17-acre field of wheat with the same knife as used in the barley, taking with them a spare sharp knife to be used if required by the judges; but although the first machine had finished in barley soon after half-past eleven, it was five o'clock in the afternoon before the dynamometer test began, and consequently only three machines were tried when the engineers broke off for the day.

Messrs. Howard's No. 49 binder had not been at work in the barley field much more than an hour when the driver's footboard broke, resulting in a permanent stop. The work done up till that time was not promising, even allowing for the badness of the plot. Several short stops had occurred, and it was noticeable that many of the sheaves presented a very tumbled appearance. We noticed several missed sheaves, too. Hornsby's 4568 binder—the new 1884—produced quite a number of untied sheaves; but, on the whole, the separation was nicely done, and the machine accomplished its task with very few stops—none of any great consequence. The variations of cut were shown with great distinctness, beginning with a 5in. stubble, dropping to 1½in., and then changing to 3in. The two acres were completed in 1 hour 28½ min. Howard's No. 45 machine did fairly good work, getting through it leisurely. With a 6ft. cutter bar, McCormick was timed at 1 hour 16 min., and the work was up to the average. All the other machines cut a width of 5ft. Messrs. Howard's No. 47 binder made a highly successful performance in most respects, the time being only 2½ min. more than Hornsby's just mentioned. Messrs. Samuelson and Co., who occupied 1 hour 28 min. with their prize binder, also scored well throughout; while McCormick, to whom the next plot was assigned, scarcely showed such good work. Hornsby's 4569 machine went through with credit, and Kearsley again proved the possibility of doing very quick work with his machine, not taking more than 1 hour 20 min. He had very short straw to deal with, and produced a good many loose and untidy sheaves. Moreover, the cut was far from being even. Wood got through in 1 hour 21 min., but the general character of the work did not rank high. Hornsby's third machine made capital progress. The second plot ballotted to Wood was certainly a very bad one, the crop being badly laid and twisted. Rough and untidy bundles resulted. McCormick, as usual, showed no inclination to hurry. He was just over an hour and three-quarters, but undoubtedly did better work than Wood, though the crop was not easy to pick up. Towards the end the cap of one of the wheels came off, causing a short stop, and until it could be found a nail did duty instead.

By Tuesday morning the competition was narrowed down to eight machines, two of the McCormick and one each of the Howard, Kearsley, and Wood make having been thrown out from the previous day, leaving three of Hornsby's, two of Howard's, and one of Samuelson's, Wood's, and McCormick's respectively. In the morning nothing was done beyond testing with dynamometer, in consequence, as far as we could gather, of the next field not being staked out and mown round. It was not ready till somewhere about one o'clock. Out of a field of 18 acres, about seven or eight were parcelled off in one piece, the eight machines being required to take a preliminary run up one side and down the other, followed by three similar cuts, officially recognised. Only one attendant was allowed to follow, and he was prohibited from touching the binder, unless called upon. This system gave the ordinary onlooker a much better opportunity of forming an opinion as to the relative merits of the competing implements. The test here assigned was much more severe than any previous one, partly on account of a boggy hollow in one portion of the field, and partly because of the flat condition of the crop. Hornsby's 4569 was the first to start, and it managed to get through without much difficulty, and with only a slight pause. Next came Wood's selected machine. It made several stoppages; a good deal of straw and grain were wasted, in consequence of the reel having been set too backward and too low; and the delivery was by no means perfect. Howard's No. 45 left a clean-cut stubble, but the nature of the crop made separation difficult, many of the sheaves hanging together. A leather band in the barley caused one stop. In Samuelson's portion we noticed an undue proportion of "baby," as well as "giant" sheaves, and some loose ones. Many heads of grain were left on the ground, in laid parts the corn and straw were considerably knocked about and wasted, and the pressure on the driving-wheel seemed to be too heavy. Still the machine got through the most difficult portions without much trouble. Howard's No. 47 had three stops in the three journeys; some sheaves were missed, and the separation was not easy. A McCormick harvester finished the day's work; it left a few sheaves unbound, and a small, badly laid, piece was uncut; but, all things considered, it did fairly all through.

Last Wednesday's trials were the most varied, most exciting, and most difficult of all. The only competitors now left were Hornsby (3 machines), Howard (2), and Samuelson (1). Hornsby made a very good commencement on the remainder of barley left from the previous day. The delivery and separation of sheaves were difficult processes to manage for all the competitors, and it may be doubted whether there was a very substantial difference in the work done. To make good performances was out of the question. Samuelson's was brought to a stop of two or three minutes in one place, and presumably for that reason they were not allowed to complete their plot. In the afternoon the judges pitched upon another piece of barley nearly an acre in extent, more flattened than ever, with the additional disadvantage of being purposely winding and hilly. For this final test Howard's 47 and Hornsby's 4568 machines were ordered out. By now the competitors were used to rough work, and they submitted to the undertaking without a murmur. Each was given a preliminary canter, and then made to go two runs of about three minutes each round the plot. Howard, who led the way, was stopped with a large hedgehog on the second round, the knife cutting deeply into the unfortunate creature, otherwise the machine went smoothly both up hill and down dale. Hornsby's machine made as nearly as possible similar work, Howard, perhaps, having the advantage with their very useful butting board. Throughout this day, more than previously, the work of the two machines seemed to be pretty nearly on an equality, so that when the last cut was taken as the clock struck three, the opinion was formed that the judges would have a particularly difficult task in arriving at a decision beyond recall. Nevertheless, an hour later the awards were announced as follows:—

Class 1.

First prize of £100 for a sheaf-binding reaper, the binding material to be other than wire: Awarded to Messrs. Hornsby and Sons, for No. 4568.

Second prize of £50 for a sheaf-binding reaper, the binding material to be other than wire: Awarded to Messrs. J. and F. Howard for No. 47.

Class 2.

Separate sheaf-binder, the binding material to be other than wire: Prize withheld.

THE INSTITUTION OF MECHANICAL ENGINEERS.

As already stated in our last impression, the proceedings of the second day of the summer meeting of this Institution, at Cardiff, commenced with the reading of a paper by Mr. Thos. Urquhart, "On the Use of Petroleum Refuse as Fuel in Locomotives." An extended abstract of this paper will be found on page 127.

The discussion upon it was longer than that on either of the papers of the preceding day, a consequence of the extensive discoveries of petroleum in several countries, and of the results which the paper gives of extended practical experience. It was opened by Mr. J. Tomlinson, who thought that although a high evaporative efficiency could be obtained with petroleum, the danger and difficulties connected with its use were such that it was only in countries where coal is absent and petroleum plentiful that it commended itself, while the cost of transport, even though that may be reduced, must always militate against its use in countries distant from oil wells, and where coal could be obtained. He pointed out that the advantage in favour of petroleum was not so great in extensive use, as shown in table, as the estimate in the early part of the paper would lead one to expect. Mr. Tomlinson generally deals with any railway question as one which should be reduced to terms of Metropolitan Railway, in order that it may be the more comprehensible, and reducing this one to this lowest common multiple, he observed that if he attempted to use petroleum on the Metropolitan Railway, he would be as much scalded as burned.

He did not say what would be the effect of a trial on the other railways with which he has been associated, though—and we know Mr. Tomlinson will not resent our remarks—in this case he might have used, say, the Taff Vale as the unit of comparison. He was of opinion that the use of the ordinary locomotive boiler, with the arrangements described, was a makeshift, as a modified form would probably secure better combustion, and so avoid the evolution of smoke which had been referred to. An arrangement such as that described would not do on the Metropolitan Railway, where such smoking could not be permitted and where the insides of the chimneys were so clean that they would not soil a cambric handkerchief. We beg Mr. Tomlinson's pardon if he did not intend this proof of the high character of the coal used on the line to be published.

Mr. Boyd gave some facts relating to several vessels fitted by his firm for trading in the Caspian. They were fitted with boilers of from 300 to 400-horse power, which had tubes of unusual length—namely, 9ft., their diameter being 2·75in. At the time these boats were made the petroleum cost about 21s. per ton, and about 2·5 lb. per horse-power per hour were used. He called attention to the great difference, as shown in the tables given in the paper, between the quantity of oil used in the summer and in the winter, and described a form of jet nozzle in which two double pipes conveying oil and steam were placed relatively at an angle of 45 deg., so that the oil supplied by one was scattered by the steam of the other, the oily steam being thus very well distributed. Mr. Boyd observed that as oil gave the means of getting steam up very quickly, the boilers were liable to suffer.

Mr. G. B. Rennie gave the results of trials fourteen years ago, when failure was caused by the use of a form of oil jet nozzle, which became choked by the impurities in the oil. The trial was discontinued, apparently because the oil was not suited to the nozzles. The saving in weight of fuel to be carried was, however, 20 per cent.; but some trials with a stationary engine in London, although at first economical, had to be discontinued because of the increased price of the oil.

Mr. Tartt, superintending engineer of a Russian company, read a statement containing the results of extended experience with liquid fuel on the Tigris, and showing that in that district it could be used with economy, although the difficulty attending the obtainment of suitable supplies led to its abandonment. The system of burning adopted was at first to place bricks loosely on the fire-bars, and cover these with ashes, upon which the oil was injected. The combustion was very imperfect, and large quantities of smoke were evolved. In subsequent trials the bridges were built up to the furnace crown, holes being left, and when the bricks became red-hot a good result was obtained.

Mr. Crampton, referring to the quantity of oil that would be wanted if the attempt were made to use it largely, remarked that the Peninsular and Oriental Company alone would use more than can now be produced. He considered that the low evaporative efficiency of petroleum, burned as described, was due to the incomplete and insufficient supply of air to it, and that this defect could be overcome by mixing the air with the steam and oil before its entry into the furnace. By means of a suitably arranged ejector this could be accomplished, and a duty of 85 per cent. secured.

Mr. F. C. Marshall gave an account of the experiences of his firm with boilers fired with petroleum, and fitted with tubes 10ft. in length and 2·5in. diameter. The long flame obtained from petroleum in these boilers, and high temperature in smoke-box, was the result of an insufficient supply of air, and to obtain this supply in such a manner as to get uniform temperature was a great necessity, but a great difficulty, and he fully concurred with Mr. Crampton in his remarks upon mixing the air with the steam and oil before its ignition in the furnace. On the Volga much smoke was evolved in consequence of incomplete combustion. He was, however, of opinion that the time would come when it would be customary with steamers trading in the Mediterranean to obtain oil fuel from the Black Sea instead of coal from England. Mr. Marshall also observed, with reference to the damage done to boilers by getting up steam too quickly, that we ought to make a boiler in which circulation was good during getting up steam.

Mr. Jeremiah Head remarked upon the effect of the mass of brickwork in the locomotive fire-boxes, which was absent from the marine, and pointed out that this would act as a heat fly-wheel or regulator, by which uniform and more complete combustion would be secured. He thought the air and fuel should be heated before entering the furnace, the importance of this being shown by the difference in the evaporative efficiency in winter and summer. It may be remarked that this difference, as shown in the tables, is equally observable with coal, and is, no doubt, consequent on the effect of low temperature on the engine, so that unless the air is heated by waste heat, it would probably be no gain to heat it otherwise than in the furnace. Mr. Head doubted the decomposition of the steam passed into the furnace, but thought it probable it passed away as steam.

A speaker, whose name we did not catch, said with reference to underground haulage, that petroleum would be no use in this country. Locomotives, he said, could not contend with ropes. It was much against locomotives of any kind to be running about always in the dark, and a petroleum-burning engine, under the best working conditions, would be too dangerous a thing to have in a coal mine. Moreover, in coal mines worked by underground locomotives, there would be as many possibilities of mishap as there were locomotives, and it was better to have the possibility of breakdown confined to one place than distributed over the workings. At many English coal mines the slack coal which is used to fire the boilers for working air compressing engines, costs but 3s. 6d. per ton, and supposing the useful effect obtained by underground compressed air engines to be but 50 per cent., and it reaches this when the air is only compressed to about 30 lb. pressure per square inch, the effective cost of the coal is but 7s. per ton, and it is quite improbable that oil will ever compete with this.

Mr. P. F. Nursey referred to a trial in 1878 on the Thames of a steamer fitted for burning oil, which worked well, but the fuel could not be regularly obtained. He also referred to the use of a small quantity of petroleum introduced with the feed into the boilers of the steamship Ida, of the Brighton Railway Company, plying between Newhaven and Dieppe, to prevent priming. It was injected at the commencement and middle of each trip. Mr. Bedson said that he had at one time a large quantity of charcoal dust—a product of his manufacture of charcoal iron—which he burned by mixing it with petroleum, but its price prevented the continuation of this plan. Mr. W. S. Tomkins remarked that the author would probably get much better results with boilers designed with a special view to the combustion of the oil, and copper boxes need not be used. Mr. Cardew, of the Indian State Railways, gave an account of his experiences in the endeavour to use petroleum as a disincrustant, the early attempts resulting in emptying the boiler by priming, but by using very small quantities he had succeeded. It was found sufficient simply to paint the tank with kerosine each time the boiler was cleaned out. Some of the water in the districts referred to in the Punjab was so bad that it used to be impossible to run more than from 100 to 200 train miles before washing out.

Mr. Druitt Halpin said he had for years used petroleum successfully as an anti-incrustator in boilers with worse water than that in the Punjab. In Lancashire boilers 30ft. by 9ft., from 1 to 1½ pints were put in through the safety valve once a week.

The president, Mr. Bell, closed the discussion, the author not being present. He agreed with the remarks that had been made as to the cost of petroleum, and pointed out that the fire-bricks referred to by the author as forming a regenerator only acted as equalisers of temperature, and not as a regenerator, as they trapped no heat which would otherwise be lost. He also pointed out that part of the difference between the actual efficiency of petroleum and anthracite as compared with the theoretical efficiency was due to the loss of that steam which was used as a jet and to other losses, and that even if the steam were decomposed, the loss which occurs in effecting dissociation would be the same as the gain in heat from the constituents. After a vote of thanks to Mr. Urquhart, a paper was read by Mr. J. H. Hallett

On the Corrosion of Marine Boilers.

The principal causes of corrosion may be discussed under the two heads of defective design and defective management, which is equivalent to saying that an ordinary marine boiler will hardly be subject to corrosion at all if well designed and well managed.

The most frequent fault is absence of space for examination. The tubes are often placed so far out in the wings that it is impossible to get down to look at the sides of the furnaces, or so close to the furnace crowns that there is no room to get over these. It would be preferable to allow at least 9in. between each furnace crown and the bottom row of tubes, especially as this row is not useful as heating surface when placed so close down to the crown. Manholes are often inconveniently placed and too small, which affords an excuse for inattention on the part of the men in charge. Manholes should always be fitted in the wings if the size of boiler will allow. A manhole at the bottom of the back end is also to be recommended. There can be no doubt that the best way to prolong the life of a boiler is to watch it carefully and constantly, so as to note the commencement of deterioration and take steps to check it. Another fault is the pitching of the steam space stays so that they come over a space, instead of over a tube, thus rendering the effective use of the scaling tool very difficult. With the object of securing the conventional 20 square feet of heating surface per horse-power, the tubes are sometimes too closely pitched, which causes bad circulation, besides rendering the spaces liable to become soon choked with scale. The tubes should never be less than 1¼in. apart, both vertically and horizontally.

The first point to be looked to in the management of a boiler is the circulation. In an ordinary multitubular marine boiler, the circulation takes place by the water ascending from the furnace crowns and the sides, backs, and fronts of the combustion chambers, and descending at the wings; the tubes do, of course, somewhat obstruct the upward current. Double-ended boilers, being longer, are more prone to suffer from racking strains, due to the difference of temperature between their upper and lower parts. One method of reducing this difference as far as possible is to fit the internal feed pipe so that it is led on a level with the upper tubes, so as first to warm the water inside it, and is thence carried down so as to discharge the warmed water in a horizontal direction at the bottom of the boiler. The scum pipe should be fitted with a pan, shaped like an inverted saucer, and placed just above the level of the water for the scum to collect under it; and it should always be blown off upon raising steam, and also about once a day when under weigh. The blow-off cock should either be attached at the bottom of the boiler, or else an internal pipe should be fitted to it, reaching down to the very bottom. Salt is not deposited until the density of the water exceeds 4-32nds by the salinometer, that is, until there is more than 4 lb. of salt in 32 lb. of water; beyond this proportion the deposition of salt then begins upon the furnace crowns, &c. It is recommended that the opportunities occurring from time to time by the engines being stopped should be taken advantage of for pumping up the boiler to the top of the gauge glass, and then blowing it down to the bottom of the glass. This repeated about twice or thrice on each occasion will work wonders. The great usefulness of this plan arises from the fact that while the engines are stopped there is little or no steam being made, and therefore no solid matter is being deposited from the water, so that the extra feed-water pumped in at that time does much more to freshen the boiler than it would if the engines were at work. When in charge of the engines of a steamer on a voyage from England to Rangoon, calling at several ports on the way, and thence to Venice, the author kept water in the boilers continuously during the whole round—that is to say, the boilers were never entirely run out and re-filled, but were blown down from time to time as above described. They were under steam about seventy-two days, and upon being opened out at the end of that time had only a slight scale upon them of uniform thickness, and no indication of pitting or corrosion. The mode of treatment adopted by the author for new boilers is to have them well washed out before filling; then to run them up, and when they are filled with water up to the normal height, to throw into each through the top manhole about a bucketful of common soda. When steam is raised to about 30 lb. per square inch, blow out a little through the scum cock. Before adding any more water, start the feed donkey, and let it deliver for some time over the side of the ship, so as to get rid of any dirt, &c., in the pump. This is a very useful precaution to observe whenever the feed donkey is employed. After starting the main engines, let them run at first with the feed-water overflowing from the hot-well into the bilges; this will clear the condenser. When under weigh, it is advisable to use the blow-down cocks sparingly. The appearance of the water in the gauge-glass shows at a glance the state of the water in the boiler; if the glass is at all dirty inside, that is proof positive of the water not being clean enough; and this can be cured by the use of the scum cock. In a double-ended boiler a scum pipe should be fitted at each end. The scum pipes are sometimes so fitted that their position can be altered to suit the trim of the ship, which is a point of far more importance than is generally imagined. After a run, when steam is finished with, the water should be blown from the bottom, and the boilers then kept thoroughly dry. Before refilling they should be carefully swept down inside, and washed out. There is no doubt that one of the most active causes of deterioration in boilers is the want of proper care in their treatment. Cases have come under the author's notice of boilers being blown down as far only as the level of the bottom manholes, and re-filled, without care being taken to draw the water out of the bottoms. This process having been frequently

repeated, the water at the bottoms became so impregnated that the heads of the rivets and the lower half of the compensating rings round the manholes were corroded away, while the other parts of the boilers were in good condition. Many good boilers are ruined through careless management, and the makers are wrongly charged with allowing their work to come from the shop not properly finished. Another example, out of numerous cases met with, is that of a pair of boilers which were fitted some little time ago with hydro-kineters, or internal steam jet nozzles for stimulating the circulation of the water in the cooler spaces below the furnace flues. Upon a recent examination the valves of these appliances were found to be hard and fast, in consequence of carelessness in supervision. Another great evil is raising steam too quickly, and blowing out under too great a pressure, which cannot be too strongly condemned. Corrosion in the upper parts of the boilers is principally caused by the introduction of oil, tallow, and other greasy substances from the engines. In all the steamers with which the author is connected, he has discarded the use of all oil or other lubricant in the cylinders, with the most satisfactory results. Various remedies have been suggested for preventing corrosion—among others, air extractors and circulating tubes. Zinc has been tried, both cast and rolled, and some engineers report favourably on its use; but to make it effective very large quantities must be used, as it so quickly oxidises, and thus loses its protective qualities. The electrogen of Mr. Hannay's invention, which is gaining favour, is a simple appliance, and, as far as the author has experimented with it, is very effective. It consists of a ball of zinc cast upon a copper bar; on each end of the copper bar a wire is soldered, and the two wires are again soldered to different parts of the boiler so as to obtain metallic contact. Boilers which had shown a tendency to corrosion looked quite healthy in a very short time after these appliances had been fitted to them. Marine boilers are not troubled with much external corrosion, especially modern boilers, because much more care is now taken in fitting them into the ships than was formerly the case. They are now properly coated, and are not fitted too close down to the bottom of the ship, plenty of room being allowed for access to the seams. But all the mischief to be contended with is not confined to the water-side of the boiler. There is nothing like cleanliness to prolong the life of a boiler. When a vessel is to be laid up, a good plan is to pump the boiler full up, to the very top of the dome, and keep it so until it is again required. Another method of preserving a boiler not in use is to empty it and clean it thoroughly, then close all the manhole doors except one at the bottom, put in a small stove full of burning coke, and close up the bottom door quickly. The object of both these methods is, of course, to exclude air as thoroughly as possible.

The discussion was opened by Mr. J. R. Fothergill, who said it was very difficult to arrive at a conclusion as to what was generally the cause, or chief cause, of boiler corrosion. Corrosion seemed to be very erratic in its nature and causes, and management might do a good deal, but not as much as the author supposed. He thought that enough was not known of the evidence given before the Select Committee on Boiler Corrosion, and in several parts of the room there was evidence of concurrent wonder. Mr. Fothergill admitted that defective circulation was more a fault of old than of new boilers, but corrosion was met with where circulation was good. He thought that there were several causes for this, such as peculiarities in the iron, and in the corrosion that takes place inside a boiler. Just above the level of the fire-bars he had met with curious experiences. He thought that air was a very active cause of corrosion, and said that as a proof of this he had hung strips of iron in a feed pipe and in the water from a condenser, and while that in the latter was untouched, that in the feed pump was rapidly eaten away. He therefore thought the removal of air from feed-water of importance. He had analysed the scum from the top of the water in some boilers, and had found it contain as much as 20 per cent. of oily matter; and this would, no doubt, under certain circumstances, have a prejudicial effect; as, for instance, it will sometimes prevent the form of that thin coating of incrustation which, he thought, formed a protective scale. He thought it a mistake to blow out boilers under pressure, or hot, and considered that they should be allowed to cool before emptying. He had found it very important, when pitting or corrosion had set in, to clean the plates thoroughly, wash with soda, and then paint with a Portland cement wash. He advocated admitting the feed-water near the water level, so as to help the removal of the air, and remarked that even if oil were not admitted by lubricators, it would enter from swabs on the piston rods.

Mr. Walker, of Cardiff, entered at length into some possible electric phases of the corrosion question, and said he thought that the inefficiency of zinc had been in consequence of its impurity. He thought better results would be obtained if the zinc were amalgamated and if it were connected with a piece of copper somewhere in the boiler, and with the boiler, at various parts by wires soldered on.

Mr. Jacobs mentioned one boiler in which, after a five months' trip with boilers unopened, the stays were found to be corroded from 1·375 to 0·875 and 0·75. The boiler was badly corroded, but after renewing the stays, cleaning the corroded parts, and coating with petroleum and Portland cement, all corrosion ceased.

Mr. F. C. Marshall thought something more should come of the Boiler Corrosion Commission, and suggested that one of its members should be invited to give the lessons to be learned from the evidence as a supplement to Mr. Hallet's paper. He then mentioned a curious case of pitting of tubes, which took place in a boiler of a steamship that stood idle for short periods after periods of work. After one of these rests, a few days' steaming showed that 140 tubes were leaking towards one end. After some trouble, it was found that the pitting had taken place at those parts of the tubes where the moisture from the half-emptied boiler collected and hung in drops. At the bottom of each pit was a small black speck. He concurred as to the harm done to boilers by air, and thought that steel boilers corroded no faster than iron boilers, but that tubes did.

Mr. Hallet briefly replied to the discussion. In reply to Mr. Fothergill, he said that the cylinders of the Blue Jacket, then at Cardiff, which had not been lubricated, were as smooth as glass, as had been seen by the members. He had in one case stopped pitting by cleaning the pitted parts, and stopping with red lead. The boiler, which had been fitted with the electrogen, had a thin scale throughout, and was in good condition.

A vote of thanks was given Mr. Hallet; and this being the last paper to be read—two others being postponed—votes of thanks were enthusiastically accorded the executive committee and officers, the owners of the works thrown open to them, and the local honorary secretary, Mr. C. Hurry Riches.

After lunch, at the invitation of the local committee, the members visited the collieries mentioned in our last impression, and, in the evening, the Windsor Gardens at Penarth. In the afternoon, some visited local works instead of going to the coal mines.

LETTERS TO THE EDITOR.

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

THE MANCHESTER SHIP CANAL.

Sir,—Mr. Browne seems to dismiss the arguments in my letter with a flourish of the pen, to his entire satisfaction. I am glad, however, that you, Sir, have considered the points I have raised so far worthy of further discussion as to reprint a large portion of my letter with the diagrams that were inadvertently omitted. As Mr. Browne says, the facts are in reality very simple; but, I ask, has he grasped them, simple as they are? What does he mean when he says: "The upper estuary of the Mersey is 'practically' filled twice a day from one end to the other by the flood tide," and when he uses the term "tidal capacity?" Having entirely missed the point of my letter, he calmly begs the question, and then kindly explains "the only theoretical principle involved," as if I had been disputing that. What Mr. Browne now calls a common-place of engineers, he spent a great deal of trouble in unsuccessfully trying to disprove not long ago.

A. C. Hurtzig.

Hull, August 9th.

Sir,—It was with pleasure that I saw from your article on the Manchester Ship Canal a tendency to consider as worthy of careful examination the scheme for the lower portion of the canal, which I have so long and pressingly advocated, both in these columns and elsewhere; to wit, the land cut from Runcorn to Garston. I am confident that the almost straight cut through the land, "beginning at a point about a mile and a-half west of Runcorn Bridge, and terminating at a point about half-a-mile south-east of Garston Docks," is much superior to any channel, either on the south side of the estuary or which merely fringes the north side, hitherto suggested. I will not trespass on your space by attempting to point out the advantages of my scheme; I have explained them before, and they will be sufficiently obvious to those interested in the subject. I would simply reiterate my conviction that, for a ship canal, the route I have proposed will be found to contain the elements of engineering success and economy of construction. From a monetary or shareholders' point of view I should prefer a canal for steam barges of, say, 800 or 1000 tons burthen, this would preclude the necessity of works below Runcorn.

James Glover.

August 11th.

WATER-TUBE BOILERS.

Sir,—Picking up your valuable paper of the 1st inst. in the reading-room of this hotel, I came across the curious communication from Richard H. Buel. For those who can read between the lines it requires no comment, but as some may not be so gifted, please permit me to say that the Babcock and Wilson Company have never descended to the bombastic bray attributed to them by Mr. Buel; neither have they ever for a moment proposed to enter upon any Don Quixotic tilt against the field of windmills. It is true that "some two years ago" they did desire the services of Mr. Buel to make some tests of a business character. The facts in relation to the disastrous failure of the American Steam Heating Company, of which Mr. Buel was engineer-in-chief, are sufficient reason why our company declined to accept his application for employment which he now parades before the public. This company should not be confounded in any way with the New York Steam Company, of which Mr. Chas. E. Emery—the chairman of the Committee of Judges on Boiler Tests at the United States Centennial Exhibition—is the engineer, and which has over 10,000-horse power of Babcock and Wilcox boilers in use; and which is a perfect engineering success. The above statement also makes it scarcely necessary to add that the extract from the Centennial Tests given by Mr. Buel is not a full, correct, or fair statement of the facts in the case.

Geo. H. Babcock, President,

Babcock and Wilcox Company, New York and Glasgow.

Grand Hotel, Paris, August 8th.

[This correspondence must end here as far as Mr. Buel and Mr. Babcock's statements regarding each other are concerned.]—Ed. E.

THE RAILWAYS OF NEW SOUTH WALES.

Sir,—As you have recently opened your columns to a correspondence anent the doings of the New South Wales Government Public Works Department—a correspondence which contains some very unpleasant personal charges—you will, perhaps, in fairness, allow a few remarks on the other side. Your correspondents "N.S.W." and "C.E." are very unsparing in their remarks, and were I disposed I could, I think, tell pretty accurately the reason for the onslaughts which have lately attracted so much attention. Knowing as I do personally both the late Minister for Works, Mr. J. Sutherland, and also the Railway Commissioner, Mr. C. Goodchap, will you allow me to protest against the charges which are so freely levelled against these two gentlemen? That the Public Works Department of New South Wales is in a bad condition I am free to admit, for I have myself no reason to be satisfied with it. I could tell you of instances of incapacity, of the appointment of known drunkards, and even of a goal-bird, were I disposed so to do; but will simply state that the abuses with which I had to contend were due to the faction which now seeks to damage the characters of Messrs. Sutherland and Goodchap. Both these gentlemen endeavoured to purify the service, and I was myself indebted to them for protection against an overbearing, insolent, and incapable superior officer. It is with regret, therefore, that I have observed the untruthful remarks which have appeared in your correspondence columns.

As regards the financial policy of the Department, I must say that it is based on wrong lines, but this is entirely due to the people of the colony. The Government encouraged and fostered immigration. The result was then, as now, that hundreds, nay, thousands of men were out of employment, and a loud cry for the "encouragement of native industry" was set up. One result of this was that locomotives were given out to be constructed by colonial makers, the price being £3600, against about £2300, for which they could have been obtained from England. Seeing that it was necessary to import boiler plates, tubes, fire-box plates, frame plates, wheels, axles, springs, buffers—in fact, almost the whole material, and that only a little turning, shaping, fitting, and erecting remained to be done in the colony, it appeared rather a mistaken idea; but the tendency of the colony is strongly protectionist, and there are, as we know, even protectionists in England. In this, therefore, there is no ground for the baseless charges which have been made.

So far as regards the rapid promotion of Mr. Goodchap, I will merely say that he was put forward in proper turn after the resignation—or death—of his predecessor, Mr. John Rae, and was considered a fair dealing man by all who found it necessary to appeal to his arbitrament.

William Hy. Booth,

Lonsdale, Flixton, Manchester, Late P. W. D., N.S. Wales.

August 9th.

Sir,—As one who has also some acquaintance with the above named, I cannot let the letter of "C.E." in your last issue go unnoticed without pointing out that the wholesale condemnation which he deals out is undeserved. It is an old-fashioned and clumsy dodge to refer to others' misdeeds when wishing to injure an opponent, and the reference to the jobbing of the "Honourable John" should not affect the character of Mr. Charles Goodchap. This gentleman has the confidence of the Government in power, and has held that position honourably, without being called upon by it to explain any misconduct; and I fail to see that because Mr. C. Goodchap is thought to be deserving of £1200 per annum, this is any proof of his "jobbing" or incompetence.

"C.E.'s" own observations of Mr. Goodchap must indeed be very limited. It is evidence that he, among many other travellers in the colonies, listens too much to such paltry scandal as is that which explains that the Commissioner for Railways was lucky because he wrote "honest John's" speeches. Colonial politicians and statesmen may not all be grammarians, but they are at least business-like men who are keen to appreciate merit and deal with jobbery and incompetence as they deserve. It is but natural that colonists should do their utmost to employ the artizans and capital which is on the spot, and this feeling and policy will never be smothered by any letters similar to that written by "C.E." The only thing done by such is to cause sensible people "at home" to question if the general political atmosphere be so black as painted—whether such men as Sir H. Parkes, whose name is synonymous with honour, his colleagues, and the members of Legislative Assembly be such rogues and fools as to countenance such jobbery and incompetence which is said by scandal-mongers to exist. I shall be obliged if you will kindly insert this in reply to the undeserved attack made on Mr. Charles Goodchap.

H. Kenneth Austin.

104, Cato-street, Birmingham, August 12th.

THE PROSPECTS OF YOUNG ENGINEERS.

Sir,—With reference to the two articles appearing in your paper on the "Prospects of Young Engineers," there are two points I should like to draw attention to. First, our ignorance of prices and time and labour. This certainly is only too true, but it is an extremely difficult thing to obtain information about. A firm naturally does not care to have it known how much it made, or perhaps, in the present state of trade, how much it lost, over a certain job, and is most particular that no one except those whose business it is to know should have any information about it. All we can do is to learn to design things the cheapest way; to put in cast iron instead of brass where we can use it; to make the unimportant part of the machine of the cheap metal, and put in liners for the working parts, &c.; and during our apprenticeship in the shops to notice how long a man takes to machine or turn a piece of work. Secondly, with regard to taking notes, you surely forget that to do so in the fashion you describe in last week's article is a heinous crime—in private firms, at any rate. Let the young engineer go down to the shop—say even during the dinner hour, when no other work would be neglected by so doing—armed with rule, callipers, and note-book, and he will soon "hear of it." In your article you speak of those of us who have had a theoretical and little or no practical training, and justly point out the evils arising therefrom. What about those of us who, having their heart in their work, have conscientiously used every means in our power to become thoroughly competent engineers? Take the career of a pupil-apprentice, which, I think, may fairly represent that of some young fellows of the present day, at any rate. He is articled to one of the first-class firms in the country, and in virtue of the premium he has paid goes through every department, and picks up all the information he can concerning every branch of work turned out by the firm. During this time he keeps his eyes open as well as his hands employed, and makes notes of every difficulty to be overcome, and the best way of doing it, as represented by the practice of the firm, and of other places whose work he may have the opportunity of observing. When out of his indentures, and having spent some time in the drawing office, he may get temporary charge of some work outside, and get a few thousand miles on the locomotive foot-plate. If he has taken up marine work he will, if he is determined to gain all the information he can, go to sea as engineer, and acquire a thorough knowledge of machinery afloat, and that readiness to meet any emergency or patch up a break down for which sea-going engineers are proverbial. He may then go to one of the schools of engineering, such as the admirable department under Professor Kennedy at University College, London. He then knows what it is he is deficient in, and he is enabled thoroughly to investigate the causes of things which have puzzled him at sea, in the shops, or the drawing-office, and about which he could find no one to give him satisfactory information at the time. He then, perhaps, obtains a place in some drawing-office again, barely earning bread and butter. How is he to obtain employment of a more responsible nature, and rise above the level of the draughtsman? Money has been laid out in paying premiums, and obtaining the practical and theoretical training described, and at present he has little or no return for it in a pecuniary sense. What are his prospects for doing better? The answer will probably be, "Wait; if you are worth anything, someone will find you out." But this waiting is an up-hill job, and many a young fellow is disheartened, and apt to sink into a mere mechanical draughtsman during the process.

A Young Engineer.

August 12th.

[*For continuation of Letters see page* 130.]

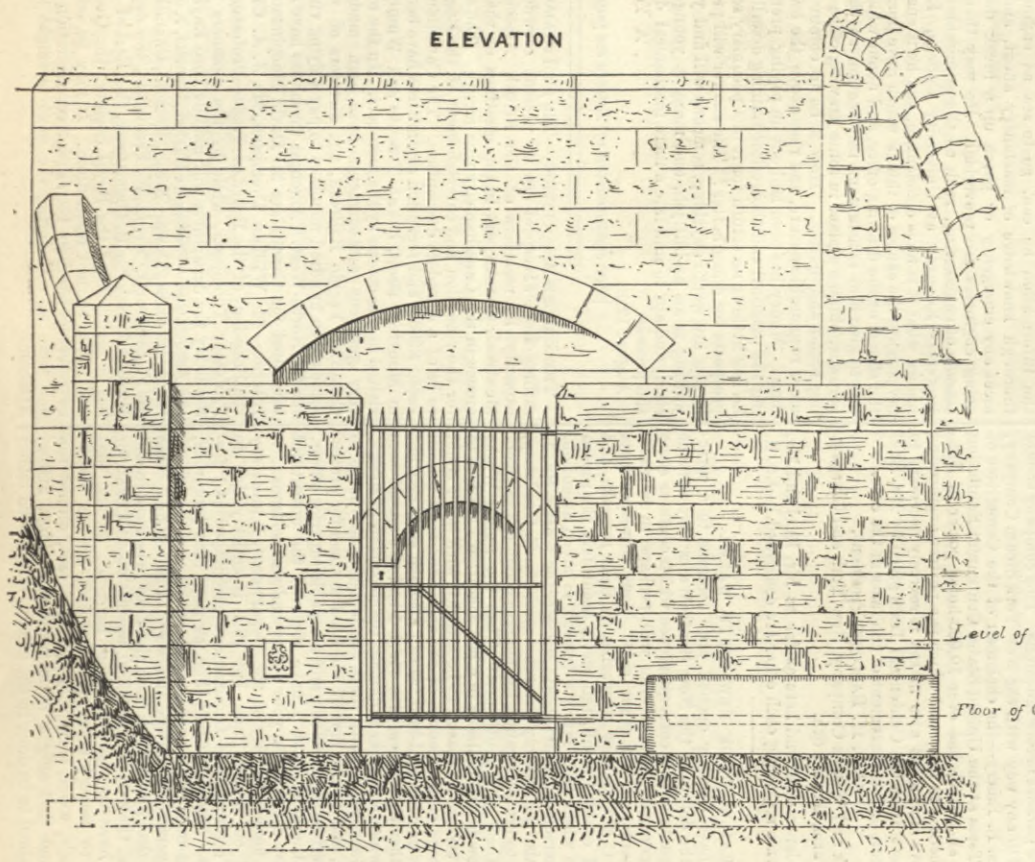
The British Association.—The mail steamers of the Allen line sailing from Liverpool are at present crowded to their utmost capacity by members of the British Association *en route* for Montreal, to take part in the meetings of that body which commence in the Canadian city this month. The arrangements made for the reception and entertainment of the English visitors appear to be of a complete description. The Canadian Government have voted £5000, and reception committees have been formed not only in Montreal itself, but at Toronto and Winnipeg, which will be visited in due course by the members. In the matter of excursions very generous arrangements have been made, notably by the Canadian Pacific Railroad, the directors of which have invited some seven hundred members to pay a flying visit to Manitoba and the far North-West. Amongst those who have already sailed from Liverpool for Canada are Sir David Macpherson—Minister of the Interior—Sir William Thompson, Mr. J. A. Chamberlain—son of the President of the Board of Trade—Professor J. C. Adams, and Professor Thompson, while by the steamers to-morrow and on Saturday the departures will include Lord Rayleigh—President of the Association—Professors Harker, Henrici, Kinch, W. F. Barrett, Boyd, Dawkins, Dewar, Frean, Reinold, Chandler, Roberts, Sollas, Sir F. Bramwell, Mr. C. W. Fremantle, the deputy Master of the Mint, Admiral Sir E. Ommanney, the Earl of Rosse, and a long list of members of the Royal Society, the Geographical Society, and other learned institutions. It may be said with truth that never before has there been such a concentration of learning afloat at one time as will during the next fortnight be borne upon the Atlantic.

MATLOCK-BATH WATERWORKS.

MESSRS. G. B. AND H. B. NICHOLS, LONDON, ENGINEERS.

(*For description see page* 121.

ELEVATION



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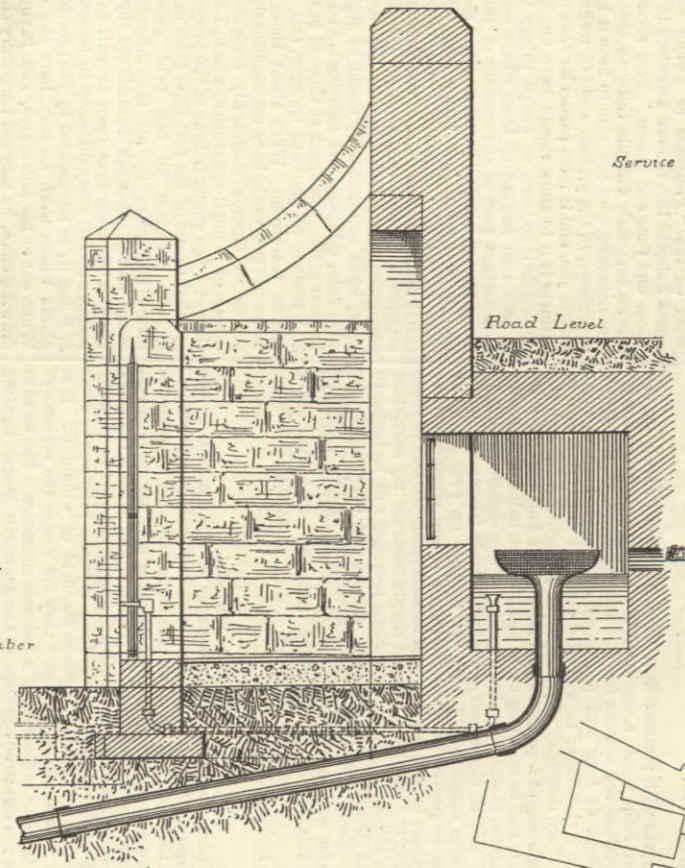
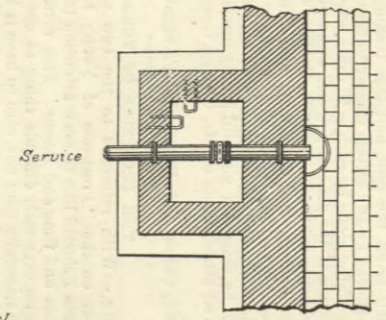
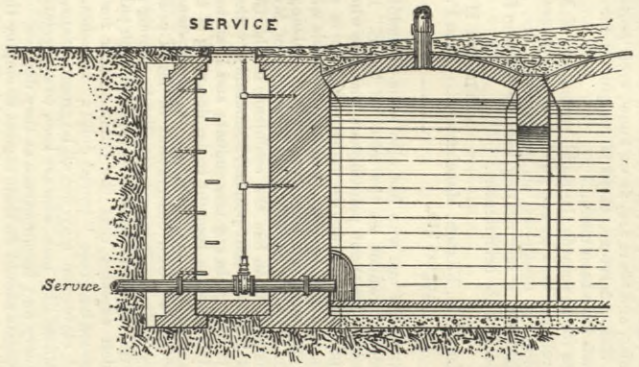




PLAN

SERVICE



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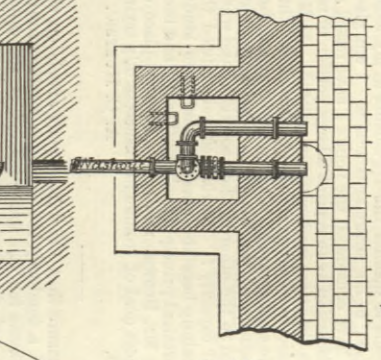
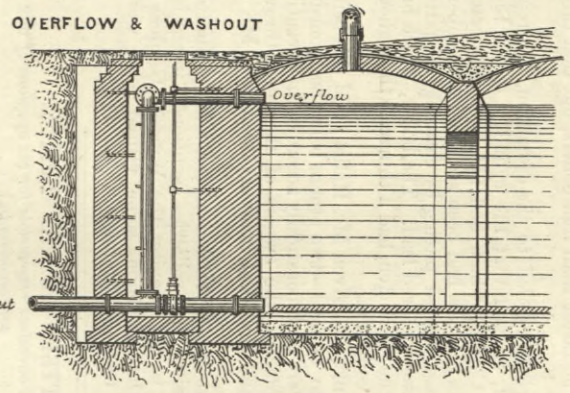


PLAN

OVERFLOW & WASHOUT



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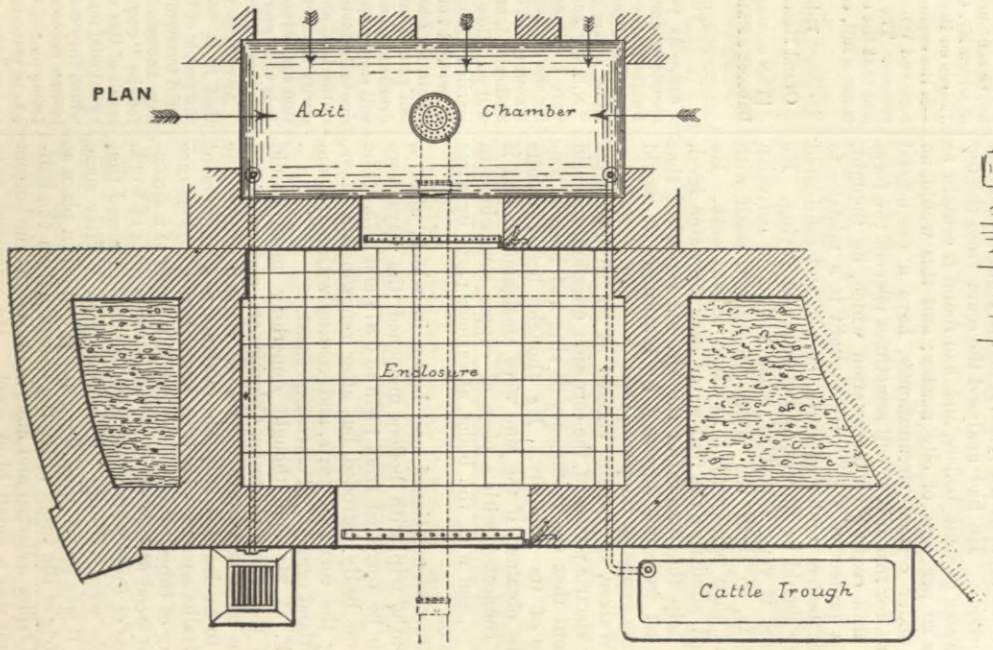
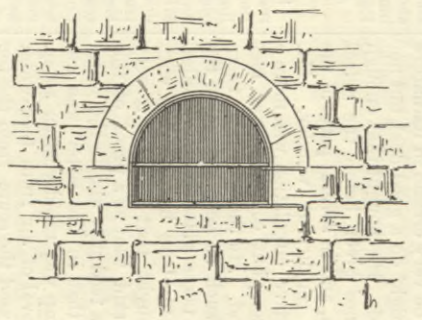
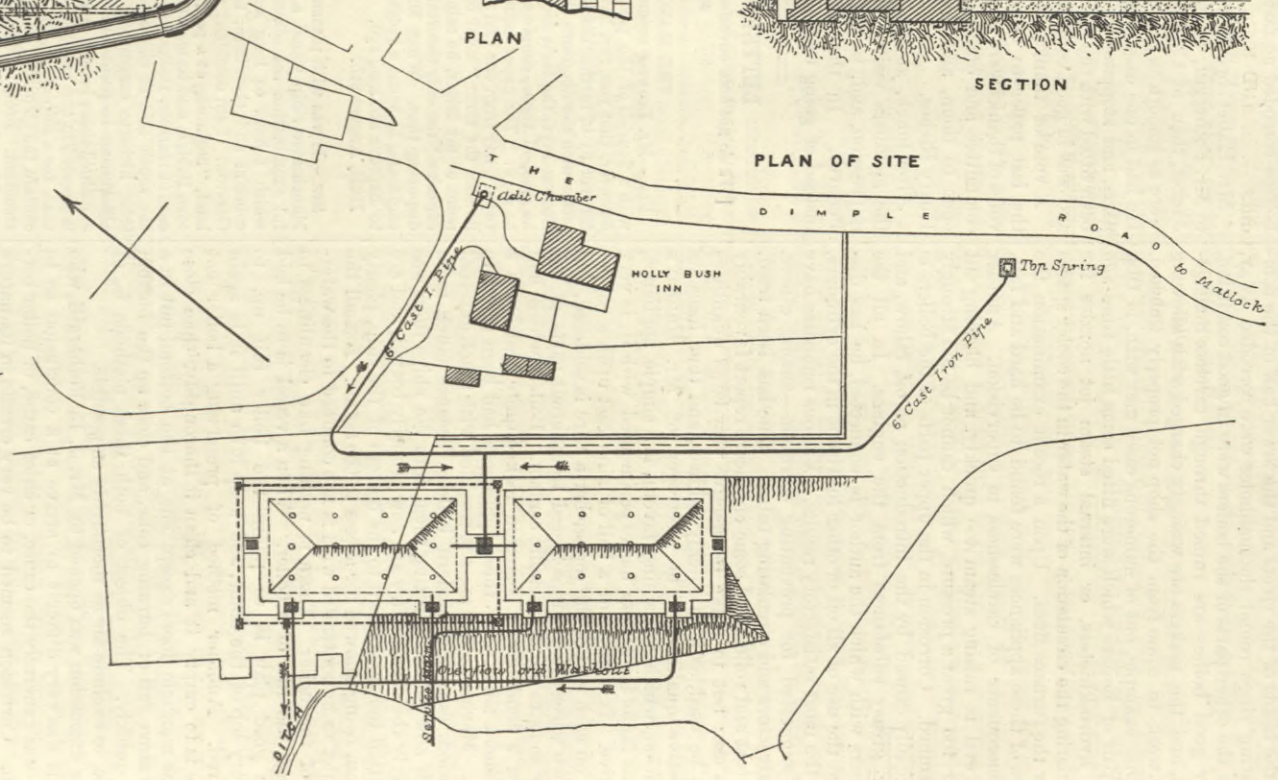
PLAN



DETAIL OF GATE TO ADIT CHAMBER

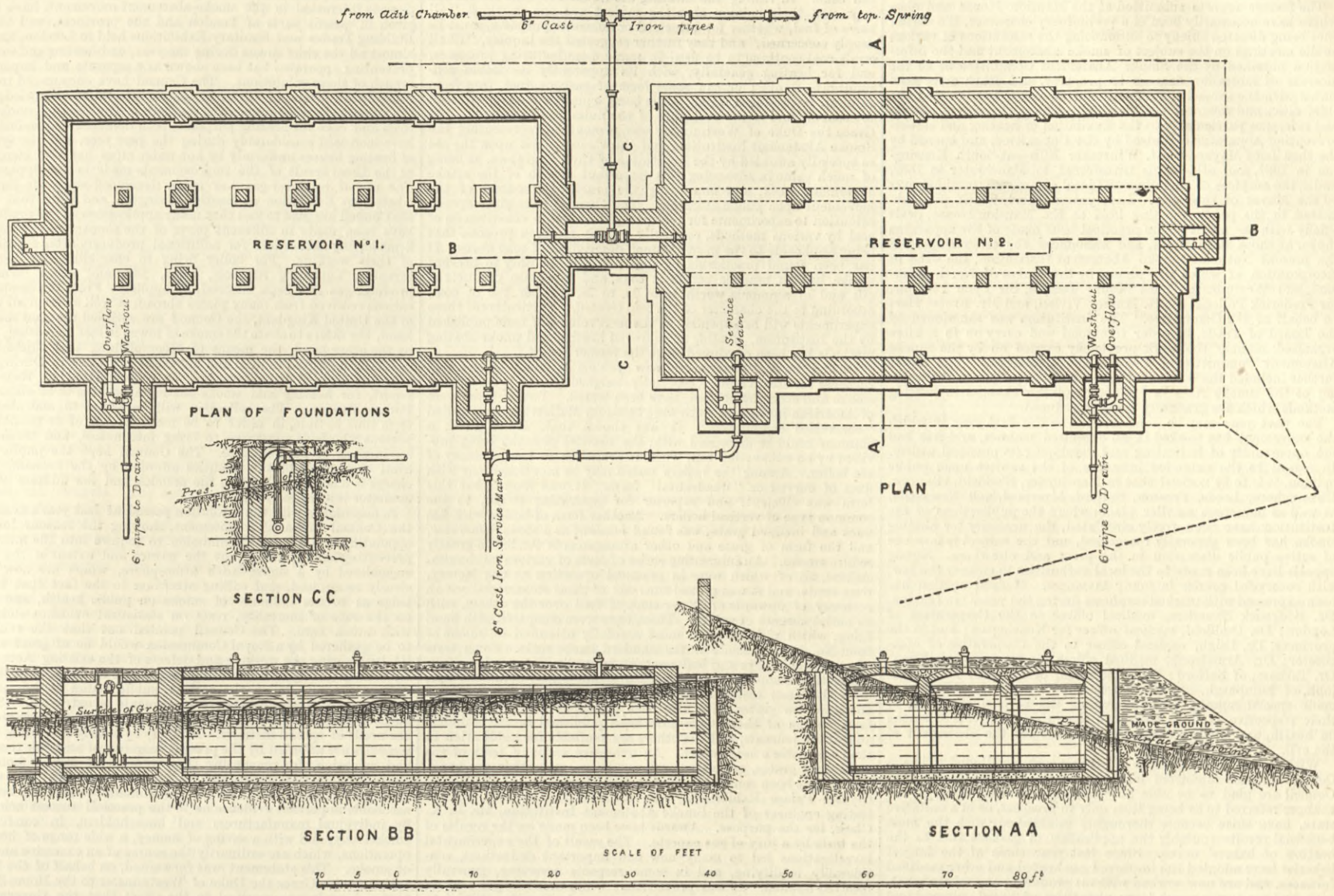


PLAN OF SITE



COVERED SERVICE RESERVOIRS, MATLOCK-BATH WATERWORKS.

MESSRS. G. B. AND H. B. NICHOLS, LONDON, ENGINEERS.



This work, illustrations of which we give above and on page 120, is now approaching completion, and is being carried out from the designs and under the superintendence of Messrs. G. B. and H. B. Nichols, civil engineers, of Queen Victoria-street, London, E.C., and Colmore-row, Birmingham. In the year 1882 the Matlock Bath and Scarthin Nick Local Board, upon the advice of their engineers, purchased the Waterworks Company's undertaking, and were appointed to reconstruct the works for an additional supply, the supply being inadequate for the increasing consumption of the district. It was found necessary to take up all the existing mains and lay about six miles of new mains, in consequence of the old pipes being corroded by the action of the soft water on the unprotected iron, which had reduced to a considerable extent the internal diameter of the pipes, the pipes being laid in the first instance without any preparation for resisting the action of the soft water.

The supply is obtained from the Dimple, in the parish of Darley Dale, about four miles from Matlock Bath, from adits and springs in the millstone grit, and the reservoirs are situated at a sufficient elevation to supply the whole of the district by gravitation. The water, which is very clear and soft, is received into two adit chambers, and is conveyed through 6in. cast iron socket pipes to each of the service reservoirs, which are constructed of equal capacity, a sluice valve being fixed in a chamber between the two reservoirs for the purpose of regulating the supply to each. The reservoirs are on the same level throughout, constructed with masonry, backed with puddle to above the water line, 60ft. 6in. long by 30ft. wide, the floors being two courses of bricks in cement on a bed of concrete, with a course of red quarries, working under a depth of water of 10ft.

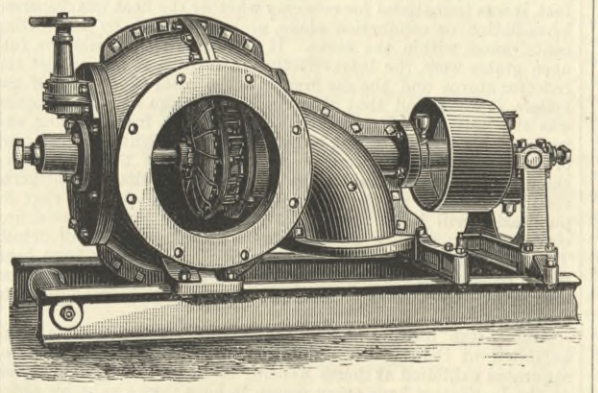
The old reservoir, which was in a dilapidated condition, and lost a great quantity of water by leakage, has been pulled down, the new reservoirs, which are partly supported by an embankment, allowing an extra pressure of 8ft. Each reservoir is provided with an inspection chamber, overflow and wash-out chamber, and chamber for service. The supply to the local board district is by means of 6in., 4in., and 3in. cast iron socket pipes, which have been supplied by the Staveley Coal and Iron Company. The contract for the pipe laying has been let to Messrs. Young and Co., of Wolston, and the contract for the new reservoirs and adit chambers to Mr. A. Palmer, Colmore-row, Birmingham, the sluice valves and reservoir fittings being provided by Messrs. Alley and Maclellan, of Glasgow. Mr. G. E. Bradley has charge of the works as resident engineer.

'TRENT' TURBINE IN MINING CASE.

The accompanying engraving represents a 12in. "Trent" turbine, with horizontal shaft fitted in a mining case specially constructed in small weights for mule transport, by Mr. Hett, of Ancholme Foundry, Brigg. The turbine is in itself practically the same as for use with vertical shaft, the only difference in it being that the shaft is made longer and the footstep is dispensed with. The runner is carried on a turned steel shaft, 2in. diameter, which projects through the curved draft tube for receiving the pulley. The shaft is supported on both sides of the pulley, the outer end being carried by an improved adjustable bridge bearing, which is specially suitable for export and erection abroad.

As it was necessary that the weight of any part should not exceed 120 lb., the spherical case had to be constructed in eight portions, so as to keep within the limit. The inlet branch is 18in. diameter, being one and a-half times the diameter of the runner, a proportion adopted by Mr. Hett as a standard for most cases, undue loss by friction, and consequent excessive speed of the flowing water, being thus avoided. The turbines being supplied with large inlet pipes, do not use the more water on that account, as some semi-technical friends assume, an amusing incident with regard to this point having recently transpired.

The case is fitted with an end cover, which admits of access to the interior without disturbing the pipe connections. The cover is provided with a sleeve for carrying the end of the turbine shaft. It is bushed with ligum-vitæ, and a lignum-vitæ thrust piece interposes between the end of the shaft and the brass screw by which the turbine is adjusted and retained in position. A corresponding screw is fitted at the other end of the shaft, with steel convex washers intervening and running in oil. The sleeve bearing on the draught tube is provided with a Stannah stuffing-box, which allows of the bearings being brought close together, saves room, and ensures rigidity. The turbine is regulated by a hand wheel worm arrangement, by

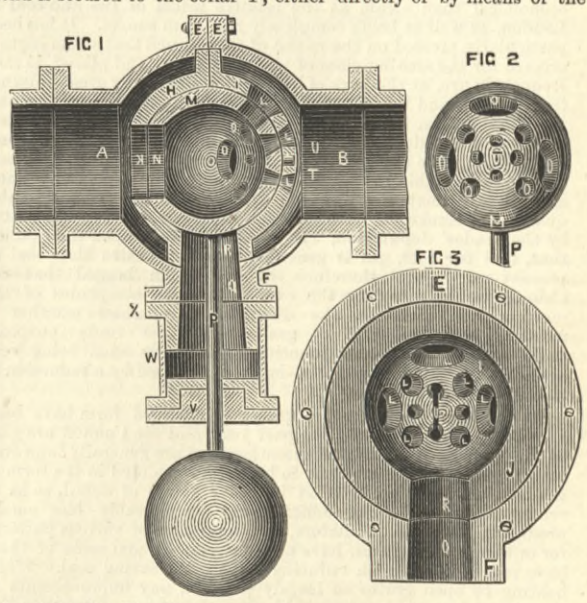


means of which the gates admitting the water to the runner can be retained in any position, to regulate the supply of water. The pressure of the water does not impede the opening or closing of the gates, as they are so balanced that the mere application of the thumb and finger to the hand wheel is sufficient to actuate them. The whole is carried by two rolled beams separated with cast iron distance pieces, with provision for holding-down bolts.

This arrangement of turbine needs very slight foundations, and is sometimes simply built into the walls of the building. It can also be placed above the tail water for convenience in driving, and as the power can be taken off the shaft direct no intermediate gearing is required.

MARINE ENGINE GOVERNOR.

In the accompanying engraving is shown a marine engine governor, constructed in such a manner as to shut off steam automatically when the vessel rolls and pitches. The two parts A B forming the shell are constructed with flanges at their outer ends for convenience in connecting with the ends of the steam pipe, and at their adjacent ends are flared into spherical form, and made with flanges E, by which they are united. In the lower side of the shell is an opening, provided with a fixed collar F, having a flange at its outer end. Within the shell are placed semi-spherical plates H I, which have flanges around their edges to fit into the rabbeted parts of the shell, and an opening in their lower side corresponding with the opening in the shell. Steam is admitted into the space between the two spheres A B and H I. In the centre of the part H is formed a large opening K, and in the other part are formed small openings that are either circular, square, or of other desired shape. Within the sphere H I is fitted a hollow sphere M, having an opening N in one side corresponding with the opening K, and in the other side are openings O corresponding in shape, size, and number with the openings L. Upon the lower side is rigidly attached a stem P, which passes out through openings, and has on its lower end a weight sufficient to hold the stem in a vertical position and the sphere M stationary, thereby causing the sphere H I to turn upon the sphere M, as the vessel rocks and pitches. This movement partly or wholly closes the openings L O, resulting in the steam being partially or wholly shut off and the slowing or stopping of the engine. The sphere M is prevented from rotating upon the stem P by a pin T—Figs. 1 and 2—which enters a vertical groove U—Figs. 1 and 3—in the inner surface of the sphere H I. The lower part of the stem passes through a stuffing-box V, attached to the other end of a short flexible hose W, whose inner end is secured to the collar F, either directly or by means of the



flanged collar X. This construction prevents the escape of steam, and allows a free lateral movement of the lower end of the stem. This invention, the description and engravings of which we take from the *Scientific American*, has been patented by Messrs. A. H. Bell and A. Fuller. The arrangement by which it becomes necessary to use the flexible hose W shirks a difficulty with little ceremony, and engineers will observe that it has the merit of simplicity, even if it is useless, as the whole arrangement most likely is, though the idea might, old as it is, be again turned to for fruits.

Chicago Pumping Station.—The new engines and pumps for the West Side pumping-works, which were contracted for nearly two years ago, are in place at last, and will to-day be formally turned to the city, and by Monday, July 21st, it is thought, they will be in operation. The pumps are two in number, with cylinders 52in. in diameter, and cost the city 257,000 dols. Their capacity is 30,000,000 gallons of water per day, which added to the capacity of the old pumps, will give the city a water supply of about 140,000,000, or a surplus over the present average demand of at least 50,000,000 gallons. The increase has been made at a total cost of about 300,000 dols., and was urgently needed, as has often been pointed out in these columns, and the work has gone along so quietly that scarcely anyone not directly connected with the enterprise has heard anything about it. And that the increase has been made without extravagant expenditures is shown by comparison with a similar improvement recently made in New York, where only 10,000,000 gallons were added to the supply, and where the cost was three times as great as 30,000,000.—*Chicago Times.*

SMOKE ABATEMENT.

The following report of the Council of the National Smoke Abatement Institution was submitted at a public meeting at the Mansion House, 16th July:—

The former reports submitted at the Mansion House and elsewhere have necessarily been of a preliminary character, the earlier ones being directed chiefly to announcing the resolutions of various public meetings on the subject of smoke abatement and the information obtained by the Smoke Abatement Committee as to the increase of mortality, damage to property, and other evils associated with the excessive production of smoke in London and the chief cities and towns of the kingdom. The next series of reports had reference particularly to the Exhibition of heating and smoke-preventing apparatus organised by the Committee, and opened by the then Lord Mayor—Sir J. Whittaker Ellis—at South Kensington in 1881, and afterwards transferred to Manchester in 1882, under the auspices of an influential local committee, presided over by the Mayor of that city. Last year's report, which was submitted to the public meeting held at the Mansion House, dealt chiefly with the result of the practical tests made of the apparatus shown at those Exhibitions, and announced the establishment of the present National Smoke Abatement Institution, the deed of incorporation of which was signed by the Dukes of Northumberland and Westminster, Lord Mount Temple, Sir Lyon Playfair, Sir Frederick Pollock, Sir H. Hussey Vivian, and Mr. Ernest Hart on behalf of the Committee. The Institution was sanctioned by the Board of Trade, in order to extend and carry on in a more organised manner the work previously carried on by the Smoke Abatement Committee of London and Manchester. The report further included the result of the Council's inquiry into the working of the Smoke Acts in London, and the changes in heating methods which are gradually being introduced.

The past year may be considered to be the first year in which the movement has worked in an organised manner, and has had the opportunity of indicating and developing its practical utility. In regard to the extended influence of the subject upon public opinion, it is to be noticed that in Manchester, Sheffield, Glasgow, Birmingham, Leeds, Preston, Salford, Liverpool, and Newcastle, as well as numerous smaller places where the publications of the Institution have been freely circulated, the necessity for abating smoke has been generally recognised, and the subject is now one of active public discussion in the press and elsewhere. Strong appeals have been made to the local authorities to enforce the law, with successful results in many instances. Medical opinion has been expressed with marked emphasis during the year. In London, Dr. Sedgwick Saunders, medical officer to the Corporation of London; Dr. Dudfield, medical officer for Kensington; and in the provinces, Dr. Leigh, medical officer to the Corporation of Manchester; Dr. Armstrong, medical officer for Newcastle-on-Tyne; Dr. Tatham, of Salford; Dr. Pilkington, of Preston; Dr. Littlejohn, of Edinburgh, and other well-known medical officers, have made special reports, officially calling the earnest attention of their respective sanitary boards to the injurious effects of smoke on health, and adding various suggestions for the abatement of the evil.

With regard to the changes in heating systems alluded to in the Council's report submitted last year at the Mansion House, the Council are glad to be able now to announce that many of the changes referred to as being then only in prospect, or in a tentative state, have since become thoroughly established, with the most beneficial results—notably the application of gaseous fuel to the heating of bakers' ovens. Since last year some of the largest bakeries have adopted the improved gas-heated and other modified furnaces, and are now worked without producing any smoke whatever, and are turning out large quantities of bread prepared and baked under conditions which are more cleanly as well as more healthy to the operatives employed than were attainable when the old style of smoke-producing furnaces were used.

A deputation recently waited upon the Council, and communications were received from various persons representing the following trades:—Bread bakers; japanning and lacquering; tile and porcelain firing; glass staining and bending; carbon preparation for various purposes; furnace builders; confectioners; restaurant keepers and refreshment contractors; coke manufacturers; gas engine manufacturers; scientific instrument manufacturers, and others, to inform the Council that smoke-preventing appliances had been widely adopted with satisfactory results. It was stated that gas engines, which are now used in numerous trades, have in the case of engines up to 20-horse power, frequently proved themselves more economical than steam at the relative prices of gas and coal in London, as well as being completely free from smoke. It has been particularly pressed on the notice of the Council that steam engines erected for the smaller class of workshops, &c., and placed, as they frequently are, at the back of buildings, cause a very great nuisance from smoke; and it is urged that as gas engines are more suitable for such trades, the erection of steam boilers in back premises situated in crowded neighbourhoods should be placed under some restriction. The number of gas engines in London has increased very rapidly within the past three years, and the total number now at work is estimated at upwards of 6000, and thus a considerable quantity of smoke has been prevented by their use. It was stated by the trades' deputation, who recently waited upon the Council that, fuel for fuel, gas is generally more expensive than coal at present prices, and therefore the deputation begged that the Council would represent the case to the gas companies of the metropolis, and invite the directors to consider whether a reduction in the price of gas supplied for trade purposes could not be made the quantity of gas now used being very considerable, and likely to be largely increased by a reduction in the price.

Several open domestic fire grates of modified form have been introduced into use during the past year, and the Council are glad to find that open grates now manufactured are generally improved by being shallower from front to back, and modified in the form of the bars and back, as well as in other points of detail, so as to render them more economical, and considerably less smoke producing. Blowers, radiators, and appliances of various patterns for ordinary open grates, have been introduced, and some of these have proved effective in reducing smoke and saving coal. While heating by open grates so largely prevails, any improvements in them must be considered particularly satisfactory. Corresponding improvements are observable in some of the modern forms of kitcheners. Coke being now delivered by the chief gas companies, broken into suitable size for burning alone or mixed with ordinary coal, and fire-brick or other slow-conducting material being used in modern grates instead of iron, have tended to considerably increase the use of coke for domestic purposes. Various simple arrangements of gas jets on the system introduced by the late Sir William Siemens for lighting coke, or urging the fire, when it requires to be suddenly increased, have been brought out recently, and have extended the use of these convenient and smokeless open fires.

The cooking apparatus for large as well as small establishments have been very materially improved. At the Drapers' Hall, in the City, as well as at various other places in the metropolis, kitchens entirely smokeless have been substituted for smoky ones; and in view of this fact the Council call the special attention of the authorities to the necessity for repressing smoke from the club-houses and hotels, restaurants, dining-rooms, &c., which now needlessly produce it in very large quantities. The improvements noticed last year in the manufacture of coke have been widely applied since, and various methods for recovering and utilising the volatile constituents of coal which are still largely dispersed into the atmosphere as constituents of smoke, have been further perfected and applied. By one of these methods small coal, hitherto an entirely waste product in most districts, is converted into an excellent fuel for domestic purposes, which is cheap and entirely smokeless, while by-products are recovered, worth at present prices fully 2s. per ton of coal treated, after providing for the cost of the process.

The Institution of Civil Engineers recently had a special meeting, and discussion upon a paper by Mr. W. Foster, upon the treatment of coal to recover the products of distillation and utilise the coke. In calling the meeting the Council of that Institution expressed their opinion that the subject was one in which "all users of fuel, whether for industrial or domestic purposes, must be deeply concerned," and they further suggested the inquiry, "Shall crude coal continue to be used in many manufacturing processes, and for heating generally, with its apparently inevitable concomitant—smoke; or can some form of gaseous fuel, free from sulphur, be produced which, while being equally effective, will lead to economy and to the avoidance of the nuisance of smoke?" His Grace the Duke of Westminster was present as representing the Smoke Abatement Institution, and the Council look upon the aid so specially afforded by the Institution of Civil Engineers, as being of much value in advancing this important branch of the smoke abatement work, and impressing the practical character of the movement upon public attention. The Council have given special attention to experiments for recovering the volatile constituents of coal by various methods, especially by the Jameson process, that being applicable to the most common description of coke ovens. It has been found practicable by that method, not only to prevent smoke, but to produce excellent coke, and to obtain products of oils and of ammonia worth from 1s. to 3s. 3d. per ton of coal, according to the character of the coal treated. Particulars of these experiments will be appended to the next volume of tests published by the Institution. Testing of improved heating and smoke-abating methods has been continued since the former report.

During the past year several new systems of steam boilers, and furnaces for steam boilers, especially designed for the prevention of smoke and economy of fuel, have been tested. Two of these were of American invention; both were based on Mallett's system called "controlled combustion." It was shown that, if required, a chimney could be dispensed with, the needful draught being provided by an exhausting fan, without prejudice to the efficiency of the boiler. Among the boilers tested may be mentioned one with flues of curved or "quadrantal" form. It was found that this form was efficient, and superior for generating steam, to the common type of vertical boilers. Another form of boiler, with flat flues and inclined grate, was found efficient as a steam generator, and the form of grate and other arrangements tended to greatly reduce smoke. An interesting series of tests of various mechanical stokers, all of which were in practical operation at one factory, were made, and it was proved that one of these stokers realised an economy of upwards of 12 per cent. of fuel over the others, with an entire absence of smoke. These tests were compared with hand firing, which yielded, when most carefully attended to, smoke of from No. 3 to 6 shade of the standard smoke scale. Some tests of special chimneys and boiler-setting have also been made. Non-conducting compositions for coating steam pipes, cylinders, &c., have also been tested, and their relative merits tabulated. Some domestic fire grates have also been tested, as well as ventilating fans. Some of these tests have been published in the technical and other journals, and the others are available for publication in the Committee's next report. An extensive series of tests of gas stoves and grates, gas boilers, gas regulators, and other gas appliances, have been conducted for the Gas Committee of the recent Crystal Palace Exhibition, who retained the services of the testing engineer of the Smoke Abatement Institution, Mr. D. K. Clark, for the purpose. Awards have been made on the results of the tests by a jury of gas experts. The result of the experimental investigations led to many new and important deductions, considerably modifying, and in some respects reversing, generally received opinion. It was proved that while under 20 per cent. of the heat generated in gas cooking stoves is directly utilised in roasting a joint—on the contrary, in gas heating stoves of the best construction the proportion of heat utilised under favourable working conditions for heating the apartment reached upwards of 90 per cent. In cooking stoves the influences of temperature, capacity of oven, quantity of gas supplied, the "jacketting," or casing of the stove, and even the proportions and material of which the stoves were made, with other elements, were closely determined; whilst the relative influence of gas mixed with atmospheric air, and plain gas burnt within the oven on the flavour of the meat, was observed and shown to be in favour of plain gas. It appears, further, that air jacketting was as effective as slag wool jacketting for cooking stoves, and that thus the objection to slag wool jacketting could be got rid of without any sacrifice of economy. It was ascertained that gas could be economically used for heating baking ovens. With regard to gas heating stoves, it was made evident that the heating of air by special provisions within the stoves was not, contrary to general opinion, found materially conducive to economy of gas; that, in point of fact, it was immaterial for economy whether the heat was dispersed by radiation or conduction alone, or in part also by air-heating contrivances within the stove. It was shown that asbestos fuel open grates were the least effective in heating rooms, whilst the reflector stoves and the gas fires were the most effective. Of gas boilers, it was found that the simplest in design and construction was the most effective, elaborate contrivances for absorbing and transmitting heat appearing to be of no special utility. The report of these tests, which were of a most complete and exhaustive character, and on a much more extended scale than any hitherto conducted, is now in the press, and the Council consider that its publication will be of the utmost value to the public in selecting stoves, and in guiding manufacturers on many points of detail. The report shows generally that marked improvements have been made, both in gas cooking and gas heating stoves, that they must tend greatly to encourage the use of these stoves in preference to coal fires.

Among the heating and smoke-abating apparatus now being exhibited at the Health Exhibition, are many modifications of apparatus exhibited at South Kensington in 1881, and the Council of the Institution have every reason to hope that a valuable series of tests will now be made, under the direction of the jury of the Exhibition, for the purpose of ascertaining the merits of new inventions, and the precise value of the changes which have been made. It is expected that the mechanical and physical tests will be conducted by the testing engineer to the Institution, Mr. D. K. Clark, M. Inst. C.E., while Professor Chandler Roberts, F.R.S., will test effluent gases by the system he adopted in 1881, for determining the composition of the chimney gases, in order to estimate the comparative completeness of the combustion of the fuel burnt in different grates, and the respective quantities of smoke produced by each. His method is fully described in the illustrated volume of "Reports of Tests" published in 1882 for the Council by Messrs. Smith, Elder, and Co. The Council are glad to find that the volume has now become a standard work of reference. Copies have been presented to the Free Reference Library of Birmingham by the Mayor, and others have been taken for official use by the Mayor of Manchester, the Lord Provost of Glasgow, and other persons in the public service. It may also be mentioned that the United States Government, who sent a special Commissioner to the Smoke Abatement Exhibition, and printed his report as a State document, have recently applied for additional copies of the reports and publications of the Institution.

The Council consider the testing of new or modified apparatus a most important and useful branch of the work of the Institution, and one which they anticipate the public will further avail itself of as time goes on. It is difficult for inventors and manufacturers to obtain satisfactory and impartial tests of their apparatus, and therefore they may be expected to avail themselves in increasing numbers of the facilities offered by the Institution; while, on the other hand, the public are at a disadvantage in judging of the character of modified systems and the relative efficiency of new apparatus in the absence of some system of independent tests. The stimulus given by competitive testing is very marked and beneficial. Even during the course of recent investigations, several cases of inventors modifying their apparatus and coming up for a second test have occurred, and, in the case of apparatus for using gas and coke for heating purposes, it may be mentioned that the newer forms of stoves are fully 20 per cent. superior in efficiency and economy to those of three years back.

Numerous lectures on cooking and heating, initiated by various persons interested in the smoke-abatement movement, have been given in various parts of London and the provinces, and at the Building Trades and Sanitary Exhibitions held in London, and in almost all the chief towns during the year, and heating and smoke-preventing apparatus has been shown as a separate and important branch of these exhibitions. The Council have encouraged to the utmost such means of advancing public interest and knowledge on the subject of smoke-preventing methods. The uses of smokeless coals and coke for heating purposes, both domestic and industrial, have increased considerably during the past year, and the system of heating houses uniformly by hot-water pipes has also increased as the direct result of the improvements made in the apparatus. The use of producer-gas has much developed since the Smoke-Abatement Exhibition at South Kensington, and since that time the Council are glad to find that many applications of gas-producers have been made in different parts of the country, many leading firms having sent orders for additional producers after experience of their working. For boiler firing to char-kilns, for heating furnaces, annealing furnaces, brick, tile, and other furnaces, producer-gas has been successfully applied. From the communications received from many places abroad, as well as from all parts of the United Kingdom, the Council are satisfied that, on the one hand, the desire to abate the smoke of towns is fast increasing, and, on the other hand, the means of accomplishing that object have generally improved in kind and increased in variety. During the year the Council have arranged, as contemplated by their last report, for heating and smoke-abating apparatus to be shown at Parkes Museum. The collection will be added to, and changed from time to time, in order to be made as useful as possible to persons who have apparatus to bring into notice, and those who are in want of such articles. The Council hope the public will avail themselves of the facilities afforded by the museum. No charge is made for exhibiting the articles, and the address of the exhibitor is attached to each.

In accordance with the resolution passed at last year's meeting, the Council prepared a statement, showing the reasons for the appointment of a Royal Commission to inquire into the means of preventing smoke, setting out the nature and extent of the evils engendered by a smoke-laden atmosphere, which are now very clearly recognised, and calling attention to the fact that knowledge as to the influence of smoke on public health, and even on the rate of mortality, rests on statistical evidence collected with much care. The Council pointed out that the evidence to be gathered by a Royal Commission would be of great value. (1) By showing the working and defects of the existing Acts. (2) By demonstrating how far it may be possible to define, extend, and enforce the powers of the various public bodies to whom the carrying out of the legislative enactments is entrusted. (3) By authoritatively determining what action should be taken in view of the needs of special districts. And (4) by clearly indicating what remedies are afforded by the present resources of scientific research and invention, for preventing the evolution of smoke from all classes of industrial works, and from private dwellings. The statement further suggested that the Commission would find readily accessible important evidence as to the practical success achieved by individual manufacturers and householders, in conducting smokelessly, and with a saving of money, a wide range of heating operations, which are ordinarily the source of an excessive amount of smoke. This statement was forwarded, on behalf of the Institution, by his Grace the Duke of Westminster to the Home Secretary. A reply was received to the effect that the Government were not disposed to grant the application for a Royal Commission. The Council regret to find that there is a very large and unnecessary quantity of smoke which should be checked by the Smoke Acts, produced in London. Numerous complaints of unnecessary smoke are also received from various parts of the Provinces. As one example—the Manchester and Salford Association write with reference to the borough of Salford, stating that "in the period of one month one man employed reported 131 breaches of the bye-law relating to smoke, and might have largely increased this number if his instructions had permitted him to observe more than one chimney at a time. The period of emission of dense black smoke varied from the time necessary to constitute an offence—namely, five minutes in the hour—to incessant emission for half an hour and more at a time. The number of observations taken by the inspector employed by the Corporation in the same period, was only fifty-five, of which the number considered offences is not stated, but the number 'reported' for offences was only seven, and of these none were fined. With regard to Manchester the Association report that two men are constantly employed taking observations, and the whole staff of nuisance inspectors—fifteen in number—have instructions to report any offences they may casually observe. The Corporation have taken new powers for the infliction of a continuous penalty of £10 a day, and the Association state their opinion that the additional penalty will be gradually inflicted, and will have a marked effect in checking the evil.

A Bill to amend the Acts relating to smoke from the furnaces and fireplaces within the metropolis has recently been introduced into the House of Lords by Lord Campbell. It contains provisions for the supervision and control of the heating arrangements of all new buildings, including dwelling-houses, in order that smoke from them may be minimised. The Bill further provides for local authorities being empowered to create, subject to the approval of the Home Secretary, bye-laws for the restraint of smoke in their respective districts, as well as to extend the provisions of the Smoke Abatement (Metropolis Acts) to the whole of the metropolitan police area, and to include under the provisions of those Acts all the trades and furnaces which are not at present included.

The Council consider the progress made during the past year has been eminently satisfactory and encouraging. They, however, deem it essential that legislation should be advanced *pari passu* with the voluntary efforts which are being put forth. As regards London, they consider it is necessary that the area now covered by the Smoke Abatement Acts should be extended, that all the trades which do not at present come within the operation of the Acts should be included, and, further, that the smoke of steamers on the river, which is now enormous and practically unchecked, should be brought under control, and the smoke from locomotive engines on the railways throughout the metropolis should also be restrained. The Council hope these changes, as well as the regulation of the heating of new buildings, including dwelling houses, will receive the immediate attention of the Legislature and the public.

Metropolitan Water Supply.—Dr. Frankland's report upon the quality of the waters supplied to the metropolis by the various water companies during July, states that the Thames waters delivered by the Chelsea, West Middlesex, Southwark, Grand Junction, and Lambeth companies were of about the same average quality as in the preceding month, the proportion of organic matter being, for river water, remarkably small. Excepting the water supplied by the Lambeth Company, which was "very slightly turbid," the waters delivered by the Thames companies were clear and bright. The Lea water distributed by the New River and East London companies was of better quality than that supplied in June, the New River Company's water being superior to any of the Thames waters. The deep-well waters distributed by the Kent and Colne Valley companies, and by the Tottenham Local Board, were of their usual excellent quality for drinking; that supplied by the Colne Valley Company had been softened with lime previous to delivery, and thus rendered suitable for all domestic purposes.

RAILWAY MATTERS.

FOR altering the North London tramways, to make the line suitable for steam, Messrs. Wilkes and Co.'s, of 17, Devonshire-square, tender has been accepted.

CATALPA timber is already in use in the south-west of America to some extent for railway sleepers. It is a wood of rapid growth, and yet has shown remarkable durability. It is being tried extensively, and it is generally believed by those who have had a long experience with it that it will outlast any other timber in use, not even excepting red cedar.

AS a passenger train on the Painesville and Youngstown Railroad was at Youngstown, Ohio, July 1st, and just as it was pulling away from a water tank, a valve in the latter broke, sending an 8in. stream of water against the train, breaking all the windows and deluging the coaches. Many of the passengers, with their clothing thoroughly water-soaked, leaped from the train, rolling down an embankment, and some were bruised. Several ladies in the train had their dresses ruined.

AT the annual meeting of the Severn Commission held on Monday, Sir E. Lechmere, Bart., M.P., said it was gratifying to find that in spite of the state of trade there had been a considerable increase this year in the traffic of the river, the tolls having amounted to £8248. Still they hoped for more prosperous years. He hoped they would from time to time exercise any influence they might have in trying to keep up those great feeders of our trade—the canals. As a member of the Committee of the House of Commons on Canals last session, he was impressed with the lamentable degree in which our canal traffic was neglected.

IN France a considerable number of local railroads have been built of the metre guage—3ft. 3⅜in.—and several are in progress. A German engineer, discussing them, says that one of the larger ones now in operation—about 19½ miles long—passes through a hilly country, and in its favour the government requirements were relaxed, so as to permit the use of curves of 100 metres—328ft.—radius, and grades of 132ft. per mile, though between stations the minimum curve employed is 984ft. radius, and the maximum grade 101ft. per mile. T-rails weighing 40 lb. per yard are used on fir and oak sleepers. The road is worked with tank locomotives, having six coupled wheels and a two-wheeled Bissell truck, weighing 18 tons empty. The cost of the road was £5000 per mile, and in the first quarter of last year it earned £12 net per mile. At the end of 1882 there were 158 miles of metre gauge road completed, under construction, or chartered in France.

FOR some years the Pennsylvania Railroad Company experimented with a view to determine the proper chemical formula for the iron for cast iron car wheels. Old car wheels, new iron and old steel rails, are melted together in certain proportions with very beneficial results. This is poured into a mould, so that the tread and not the flange comes into contact with the iron chill. These wheels are afterward annealed and allowed to cool gradually, three days being thus consumed. The superiority of these wheels was shown at a recent test, when eighty-seven well-delivered blows were directed on the same spot on the side of the wheel with sledges weighing about 20 lb. before the iron yielded, the chilled iron in the tread not even being cracked. Of 80,000 wheels made in 1883 only two wheels were broken in service. So much we learn from the American *Railroad Gazette*; but why does our contemporary omit the important part of its story, and forget to tell us what the mixture is—how much old rails, how much old wheels?

THE dispatch published from Cleveland, O., July 27th, says:—"The first electric railroad for public use in America went into operation in this city yesterday, in connection with the East Cleveland-street Railroad Company, which has just completed a mile of road. The experiment was so successful that the company expects to change its entire system, comprising over twenty miles, into electric roads. The system used was a combination of the Brush and Knight and the Bentley systems, and the current was carried on underground conductors, laid in conduits like those of cable roads. The cars were started and stopped and reversed with the greatest ease. Any number of cars up to fifteen can be run at one time on a single circuit and from one machine, which is a result not attained by any of the European systems now in operation. The success of the new road has made a great sensation in both street railroad and electrical circles, and is expected to greatly extend the field of electrical development, as well as enhance the value of street railroad properties."

THE Pennsylvania Railway Company uses an oil testing machine. A journal is made to revolve in a bearing at the same rate as when a car wheel moves—15, 30, and 60 miles an hour. The amount of heat produced by the friction is accurately shown by a thermometer, while a pendulum moving upon a graduated arc shows the amount of friction or resistance, the wearing quality of the lubricant being determined by the length of time it will stand the test. About 1 lb. of phosphor-bronze bearings is worn away under a car for every 25,000 miles run, or two ounces for each bearing, the journals being supplied with the standard lubricant. The testing of the oils alone has resulted to the great pecuniary advantage to the company; and the honest manufacturer has shared the benefit with the company, since he is now able to sell good material to a better pecuniary advantage than when brought into competition with adulterated goods. Some idea of the accuracy of the tests may be gathered from the fact that a non-believer in the system who was requested to adulterate some materials and make a memorandum of the proportions used, was afterwards handed a test report, which coincided almost identically with his figures. He immediately became a convert to the system.

ACCORDING to an American official report just published, in Ecuador there are one general railway and four street car lines. The railway is a Government enterprise, upon which work was commenced in 1872, and suspended in 1877. At its inception this line was designed to form part of an improved means of communication between Guayaquil and Quito, a distance of 270 miles. Proceeding northerly from Guayaquil for twelve miles, Pueblo Neuvo is reached, to which place steamboats run. At this place the railroad of 3ft. gauge was started—now its southern terminus—and built northerly, and put in bad running order for about forty miles. As far as constructed the grade is nearly level. It was designed to build the line about forty miles further, ascending to an elevation of over 7000ft., but frequently recurring revolutions in the country have stopped general progress, and that part of the work constructed is now in a dilapidated condition. Part of the original plan was to construct a good wagon road from the end of the eighty miles of railway to Quito, and this road was constructed; but the impassable forty miles render the whole route unserviceable, and both the wagon road and the railway are sources of great national loss.

CONSIDERABLE success having attended the working of German tramways, it naturally follows that fresh concessions are watched with a considerable amount of interest by the tramway world. The City of Magdeburg—one of the richest in Germany—has since the close of the war made rapid strides in connection with the formation of new streets, some of which are of great width, and in the erection of stately buildings, bridges, fortifications, and other works of an engineering and architectural character, and with its increase of population and larger area of district, tramway locomotion has become a necessity. At the present time there is a small service of one-horse cars through a portion of the city, and this undertaking, which is worked by a company, has been most successful as a financial speculation. A fresh concession of some 20 kilometres in length has been issued by the city authorities, and Mr. John Fell, of Leamington, has secured the concession. He is also the contractor for the work, the sub-contractors being Messrs. Damm and Wendland, of Berlin. The works are being carried out in accordance with the plans and specifications of the engineer, Mr. Edward Pritchard, M. Inst. C.E., of Westminster and Birmingham; and the first portion of the line is to be ready for working by the 1st November, 1884.

NOTES AND MEMORANDA.

THE effective armoured fleets of the leading naval Powers of Europe might be summarised as follows:—England, 329,520 tons; France, 201,789 tons; Germany, 74,007 tons; Austria, 63,110 tons; Russia, 83,621 tons; Italy, 59,905 tons.

THE new postal routes opened in New South Wales during 1883 amounted to 1703 miles. The extent of postal route traversed in the colony on December 31st, 1883, was 25,162 miles, as compared with 23,923 miles traversed in 1882. The number of miles travelled in the year 1883 was 6,264,300, being an increase of 402,983 on the mileage of the previous year.

AT a recent meeting of the Paris Academy of Sciences, a paper was read on a study of the deviations of the pendulum at Fort Loreto, Puebla, Mexico, by M. Bouquet de la Grye. These observations were conducted by means of a multiplying seismograph set up in connection with the expedition sent out to observe the transit of Venus. Their object was to ascertain how far the oscillations of the ground and the phenomenon of tides may be determined by the vibrations of the pendulum in volcanic and mountainous regions.

IN the "Comptes Rendus" for the 28th ult. is a note on the analytical calculating machine invented by Charles Babbage, by General F. L. Menabrea. The author gives a full description of the machine left incompleted by the inventor. He also gives an unpublished letter of Mr. Babbage, dated August 28th, 1843, and certifying that the anonymous English translation of Signor Menabrea's original account of the machine, which appeared, with some brilliant accompanying explanations, in the third volume of the "Scientific Memoirs," was by Lady Ada Lovelace, only daughter of Lord Byron.

THE number of workmen employed in our dockyards at home increased from 1879 to 1884 from 16,381 to 18,849. The armoured building had been advanced from 7427 tons in 1879-80 to 12,614 tons, as proposed in the Estimates for 1884-85. The expenditure on armoured building for 1883-84 and 1884-85 was actually doubled as compared with 1879-80. For the protection of our vast commerce in every part of the globe we maintain a fleet in commission with an aggregate displacement of 324,256 tons, as compared with 171,300 tons for the French. Our fleet in commission was more than double the tonnage of the French, but our mercantile marine was tenfold larger than theirs.

THE deaths registered in twenty-eight great towns of England and Wales for the week ending August 9th corresponded to an annual rate of 21·9 per 1000 of their aggregate population, which is estimated at 8,762,354 persons in the middle of this year. The six healthiest places were Bristol, Brighton, Bradford, Huddersfield, Sunderland, and Norwich. In London 2212 births and 1624 deaths were registered. The births were 349 below and the deaths exceeded by 29, the average numbers in the corresponding weeks of the last ten years. The annual death-rate from all causes, which had been 26·1, 25·9 and 22·9 per 1000 in the three preceding weeks, declined last week to 21·1. During the first six weeks of the current quarter the death-rate averaged 23·3 per 1000, against 24·2, 18·2, and 20·7 in the corresponding periods of 1881, 1882, and 1883.

THE *Centralblatt fur Textil Industrie* records the fact that antimony is to be found in cotton yarn which has been dyed with aniline colours, and remarks that unless great care has been taken in the cleansing of the yarn, it is possible for such a quantity to remain as to be injurious to the skin. Experiments made on different classes of yarn produced results varying according to the nature of the dyeing substance. The samples in which hot water acted as a dissolvent showed only a small proportion of antimony, the highest proportion found being 0·014 per cent. The proportions of antimony which were soluble in muriatic acid varied from 0·036 to 0·31 per cent. of the weight of the yarn. Of course, practically speaking, only the portion soluble in water comes under consideration, but as a pair of long stockings weighs about 2 oz. to 2½oz., the antimony would represent an appreciable though minute quantity, the effect of which is a question, it is remarked, for medical experts to decide.

THE Imperial Canal of China is over 1000 miles long. In the year 1681 was completed the greatest undertaking of the kind in Europe—the canal of Languedoc, or the Canal du Midi, to connect the Atlantic with the Mediterranean. Its length is 148 miles; it has more than 100 locks, and about fifty aqueducts, and in its highest part it is no less than 600ft. above the sea; it is navigable for vessels of upward of 100 tons. The largest ship canal in Europe is the great North Holland Canal, completed in 1825. It is 124ft. wide at the water surface, 31ft. wide at the bottom, and has a depth of 20ft.; it extends from Amsterdam to the Helder—51 miles. The Caledonian Canal, in Scotland, has a total length of 60 miles, including three lakes. The Suez Canal is 80 miles long, of which 66 are actual canal. The Erie Canal is 350½ miles long; the Ohio Canal, Cleveland to Portsmouth, 332; the Miami and Erie, Cincinnati to Toledo, 291; the Wabash and Erie, Evansville to the Ohio line, 374. The Suez Canal is 26ft. 4in. deep, 72ft. 5in. wide at bottom, 329ft. wide at water surface; length, a little short of 100 miles. The Panama Canal is to be 45½ miles in length.

THE following are kiln drying temperatures adopted by Franz Chodunsky, a well known Bohemian maltster. At the time of charging the kiln, a temperature 108½ deg. F. should be indicated by the thermometer hung underneath the upper floor of the kiln; two hours afterward the temperature should be 111 deg.; at the expiration of three hours, 113 deg.; and at four hours, 117½ deg.; after five hours, 122 deg.; after six hours, 133 deg.; after seven hours, 144½ deg.; and at the expiration of eight hours, from 156 deg. to 160 deg. The maltster ought not to allow a variation of more than 4 deg. from the above temperatures. The temperature of the malt on the upper floor is thus under control, and ought to acquire the following temperatures at each successive hour:—87 deg., 84 deg., 86 deg., 99½ deg., 102 deg., 111 deg., 117½ deg., and 131 deg. The malt should reach the lower floor of the kiln at 129 deg., and pass from hour to hour to the following temperatures:—117½ deg., 116½ deg., 130 deg., 133 deg., 147 deg., 171½ deg., 178 deg. The malt is charged at the rate of 1·25 hectolitres per square meter (=nearly 3 bushels per square yard) the thickness of the layer of grain should be a little over 3in. at first; after four hours, about 2⅝in.; and after eight hours rather less than 2½in. On descending to the lower floor of the kiln, it should not exceed the last named thickness, and toward of the middle of this stage the thickness should be reduced to 2in., and at the end of the kiln drying be a trifle less.

DR. R. LENZ describes, in the last "Bulletin" of the St. Petersburg Academy of Sciences, a new application of the telephone to the measurement of temperatures at a distance. Let us imagine two stations, A and B, connected together by an iron and a silver wire, which are looped together at both stations. If the looping at A has a different temperature to that of B, a thermal current will circulate through the wires; and if a silent interrupter and a telephone be introduced into the system, the telephone will emit a sound, which will cease immediately the observer at B has raised or lowered the temperature of his looping place, so as to render it equal to that of A, and to destroy thus the thermal current. The exactness of this method depends on the exactness of determination of the moment when the lull ceases in the telephone, which moment is influenced by a remnant of lull in the instrument after the equalisation of temperature at both ends of the apparatus. In a series of experiments where the points A and B were one metre distant, Dr. Lenz determined temperatures by this method with great accuracy, the errors being only from 0·01 deg. to 0·17 deg.; and he concludes that, by using iron-argentan wires two millimetres thick, the measurements could be made at a distance of five kilometres, which distance, *Nature* says, could be still increased, say, to twenty-five kilometres, if antimony and bismuth wires were used.

MISCELLANEA.

JOHN ERRICSSON, the engineer, attained the age of eighty-one on the 30th of July.

WE are requested to announce that Mr. Heber Duckham, of 35 Queen Victoria-street, E.C., has resigned the London agency for the Midland Railway Carriage and Wagon Company, and that his engineering business will be carried on as heretofore at the above address.

AT Messrs. Wm. Cooke and Co.'s, Tinsley Iron, Steel, and Wire Works, on Monday, a vertical boiler exploded, causing the death of four persons and injuring seven, more or less severely. The inquest has not yet been held, and the cause of the accident has yet to be ascertained. Much damage was done to the works, but the machinery escaped with comparatively little.

ARRANGEMENTS have been made for a visit of the Members and Associates of the Society of Engineers, on Thursday, the 21st inst., to the extension works of the South Metropolitan Gas Company, East Greenwich, and the chemical works of Messrs. Sadler, Forbes, Abbott, and Co., Limited, East Greenwich. Members and Associates will assemble at the works of Messrs. Sadler, Forbes, Abbott, and Co., Limited, Ordnance Wharf, East Greenwich, at 12.30 p.m.

A NEW twin-screw hopper dredger, of 800 tons capacity, built and engined by Messrs. W. Simons and Co., was on the 7th inst. launched complete from their works at Renfrew; it is named Espana, and it is the property of the harbour authorities of Valencia, Spain. It is fitted with two separate sets of compound engines, steel boilers, and traversing bucket girder to cut its own flotation. This vessel will carry 800 tons of its own spoil at a speed of ten miles an hour. This is the nineteenth hopper dredger Messrs. Simons and Co. have constructed, and they are the inventors of this system.

A TRIAL of the Grinnell fire extinguisher was made last week at the works of Messrs. Mather and Platt, Salford. This apparatus is constructed on the same principle as the Parmelee system, but more rapidity of action is claimed for it. Lines of small pipes connected with a water supply always kept under pressure are carried through a building near the ceilings, and to these are attached automatic fire-extinguishers, so constructed that in the event of a fire the heat generated would melt the fusible solder that secures a valve, by which means water is at once liberated and discharged upon the fire. The solder fuses at a temperature of 155 deg. Fah., and in addition to the turning on of the water an alarm bell is rung. The trials, it is said, were regarded as thoroughly satisfactory.

THE Brunswick Rock Asphalt Paving Company's tenders have been accepted for laying with asphalt 1in. thick—20,185 superficial yards—seven warehouses in the Royal Victoria Docks for the London and St. Katherine Docks Company; for laying the footway of main line entrance to Liverpool-street Station for the Great Eastern Railway Company; for the whole of the asphalt work required at the new Mansion House Station for the Metropolitan District Railway Company; for the laying of the whole of the asphalt required at Sunderland Station for the North-Eastern Railway Company; for laying the floors of new buildings at Caterham Asylum for the Metropolitan Asylums Board; for paving women's yards, &c., City of London Union, Homerton; and for paving the school grounds of St. John's, Wapping.

THE Americans are taking another leaf from our book. The old beam engine for steamboats will soon become a thing of the past. A new cargo boat for the Providence and Stonington Steamship Company was launched at Noank, Connecticut, within the last fortnight. She is intended to run between Stonington and New York, in connection with the New York, Providence, and Boston Railroad. The boat is 305ft. long, and will have the Morgan feathering paddle-wheels. The peculiarity of the boat will be that, instead of the beam engine so generally used on paddle boats in Eastern waters, she will have compound oscillating direct-acting engines. The high-pressure cylinder will be 42in. diameter, and the low-pressure cylinder 78in., both being 10ft. 6in. stroke, an unusual length for engines of this class. The oscillating engine is going out of fashion in this country, only our American brethren are somewhat behindhand in shipping matters.

ON the 8th inst., shortly after midnight, the Abercom Shipbuilding Company, Paisley, launched a coasting steamer of 200 tons burthen, built for Mr. D. P. McDonald, of Fort William, to the designs and under the superintendence of Messrs. Mac Nicoll and Co., Glasgow. The construction is extra strong to provide against grounding in harbour while loaded, and is in excess of Lloyd's requirements for the class, which is the highest in their books. A number of improvements unusual in coasting steamers have been introduced for the sake of efficiency and despatch. The anchors are Smith's stockless, and are drawn up into their position for the voyage by the windlass without catting or fishing out of danger of fouling anything, and yet ready to let go at any moment. Water ballast in partial double bottom and in peaks, and beltings and side heels of steel plating, have been fitted. Powerful machinery, with two steam winches and donkey boiler, will be fitted by Messrs. Hanna, Donald, and Wilson, Paisley.

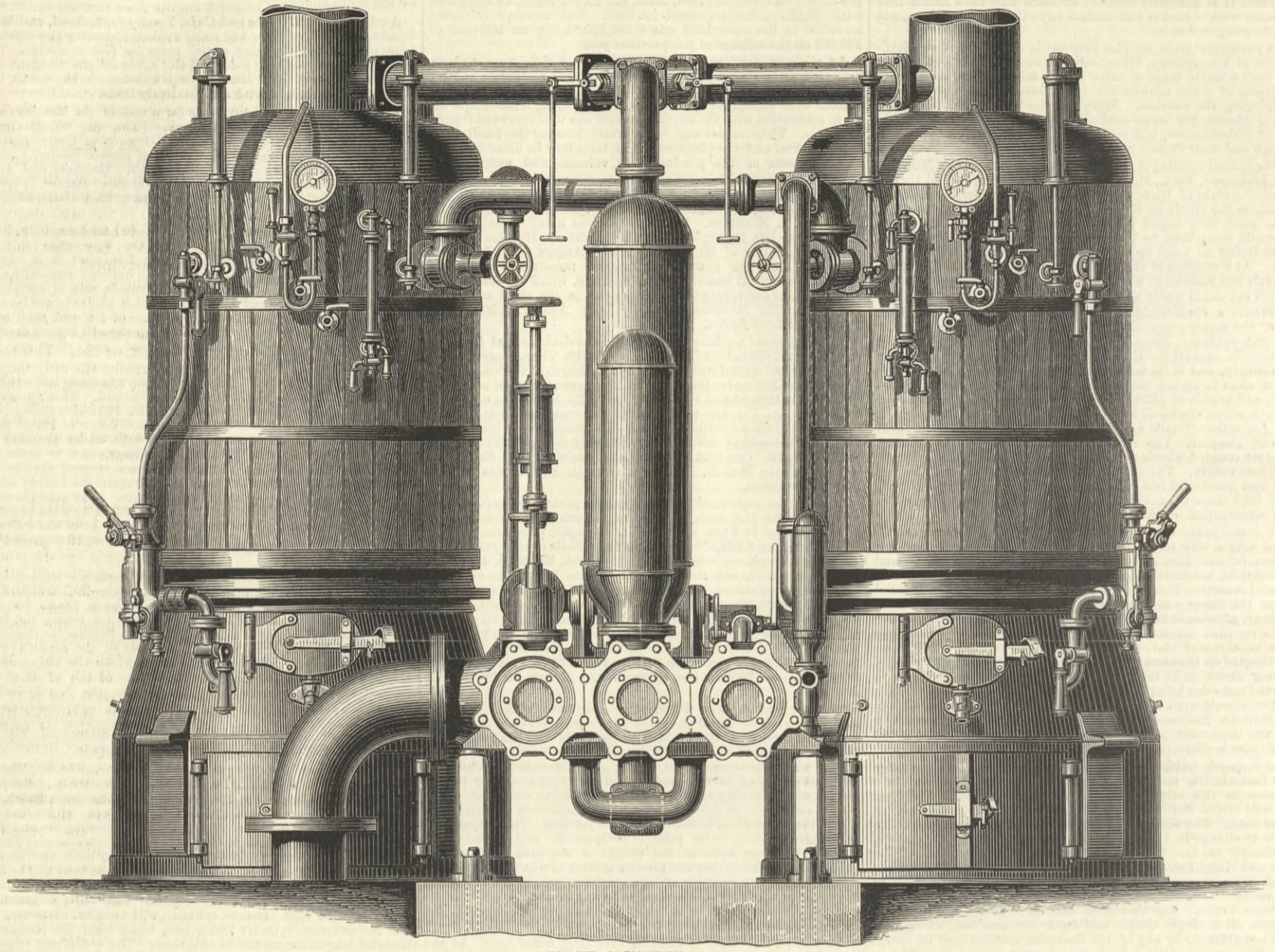
THE Abyssinian tube well for the entire supply of the town of Hertford has been completed by the contractors, Messrs. Le Grand and Sutcliff, with most satisfactory results. The size of tube well is 7¼in., and at 81ft. the chalk springs are so abundant that the yield is over 100 gallons per minute, or about 150,000 gallons per day. The pumping, when necessary, can be continued night and day with a very small amount of attention, as the motor is a powerful water-wheel worked by the river Lea. This well affords a further illustration of the fact stated by Mr. Robert Sutcliff at the recent Water Supply Conference held at the Health Exhibition, that it frequently happens there is abundance of good water to be found on the banks of a river that is no longer itself fit to supply water for dietetic purposes. The total saving of the expense of filtration is also a very important item, which might to some extent recompense the London water companies for the expense of obtaining their supplies from sources that need no outlay on this head. The total cost of the tube well, including cast iron connections to pump, was under £150; so that the town supplies on this system cannot be considered extravagant.

A NEW patent-office is being built at Washington. An American contemporary thus describes it:—"One of the queerest structures in the world is the new patent-office, which covers one side of the open space known as Judiciary-square. It is to be three stories in height and of immense width and length. The central part will have a great concave elevated roof, and there will be a court yard big enough for the next inauguration ball. The walls are now nearly completed to the top of the second storey. The roof of the building will not be on much before winter, but already preparations are making at the present pension-office to occupy the lower storey of the new building. The explanation is that the building is composed entirely of brick and terra-cotta. The ceiling of each story is composed of brick arches and is not affected by water or fire. It is to be, in short, absolutely a fireproof building. General Meigs, who has charge of the construction, believes that it will last forever substantially, without cost for repairs, except those which may be required on the roof. No other Government building offers so little opportunity to the elements to destroy it. No other building will have cost so little in comparison with the extent and utility of its interior. A whole army of clerks will have a comfortable, well lighted, well ventilated place of occupation on its three great floors. When the Government does not need it for a patent-office, if such a time should come, it will be just as good as new, and could be used for a museum or storehouse for documents or anything else. It is likely to have a marked influence upon the public buildings of the country, teaching architects how to study economy, strength, and durability in building for the Government."

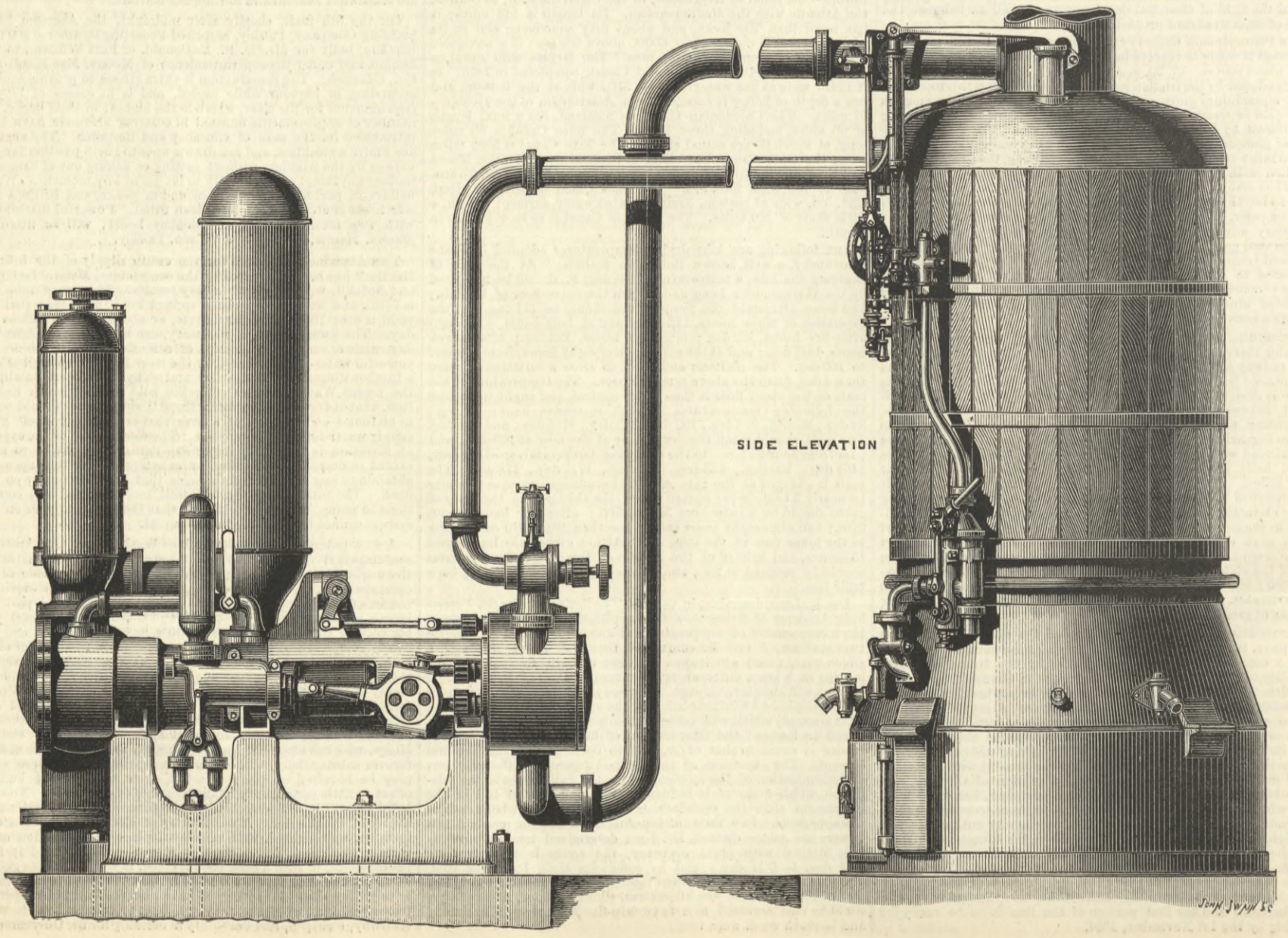
STEAM FIRE ENGINE, OSBORNE HOUSE.

MESSRS. SHAND, MASON, AND CO., LONDON, ENGINEERS.

(*For description see page* 128.)



FRONT ELEVATION



SIDE ELEVATION

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*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

E. DU B.—*We do not know anything about the motor.*

COUNTRY READER.—*There are no such appointments. You have been misinformed.*

J. B. C. O.—*Tram-cars were first run in London about* 1861 *by Mr. George Francis Train.*

D. P.—*You can ascertain by addressing a note to the Great Seal Patent-office, Chancery-lane. The change in the law has rendered it impossible for us to continue the list.*

R. V. (Vienna)—*There is no gun factory in private hands in England which can compete with Krupp's, save that of Messrs. Armstrong and Co., Newcastle-on-Tyne.*

E QUIRER (Tipton).—*From* 20 *to* 40 *tons. Some engineers hold that* 20 *tons is quite sufficient to close a* 1*in. rivet in boiler work, while others hold that double that pressure is requisite to make sound work. The subject is one often discussed, of considerable importance, and not even in a fair way to being settled.*

MATCH-MAKING MACHINERY.

(*To the Editor of The Engineer.*)

SIR,—Can any reader kindly give me the address of any manufacturers of match-making machinery? R. A.

London, August 14th.

RUSSIAN GRAIN VANS.

(*To the Editor of The Engineer.*)

SIR,—Some few months ago the representatives of the Russian Railway had their conference and offered prizes for the best grain van; now I cannot find the address of the secretary or president. Can any reader assist me? ROLLING STOCK.

Shrewsbury, August 11th.

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THE ENGINEER.

AUGUST 15, 1884.

THE DOWNTON CATASTROPHE.

THE London and South-Western Railway has never enjoyed an excellent reputation; and the report of Colonel Rich on the Downton railway "accident" will not raise it in the esteem of the travelling public. In another place we give a sketch of the position of the vehicles after the train left the rails, and Colonel Rich's conclusions in full. It may be worth while briefly to recapitulate. On the 3rd of June a train on the Salisbury and Wimborne section of the South-Western Railway ran off the road, and down an embankment between Downton and Breamoor stations. The train consisted of two tender engines, a brake van, two third, two first, one second, and one third-class carriages, and a brake van in which was the guard. The engines and tenders had steam brakes. The engines kept on the road, but the tender of the train engine left the rails, as did the brake van, but kept on the road while the remainder of the train, as we have said, ran down the embankment. Three persons were killed, and forty-one more or less injured. With the major portion of Colonel Rich's report we agree; we do not, however, think he is right in stating that two engines are a source of danger to a light train. They may be, or they may not be; but no fixed rule, such as he seems disposed to lay down, can be made on the subject. It will be seen that Mr. Adams holds that a draw-bar broke; then the strain came on one of the side chains, which gave way, and the other pulling at an angle dragged a carriage off the rails, and so the accident occurred. Colonel Rich rejects this theory in far too summary a fashion. There is much to be urged in its favour; but we are disposed to regard this breaking of draw-bars and chains as secondary events, and not the primary cause of the disaster, which may, we think, be explained in a way different in some respects from that suggested by Mr. Adams and Colonel Rich, while having points coinciding with both.

It is well known to those who have much experience in riding on locomotives, that some engines when running at speed, especially down inclines, will now and then begin to "wander" on the road. The motion of which we speak must be felt to be described. Ordinarily a locomotive jumps and twists, and jerks and vibrates, and pitches up and down. The violence of the motion varies with the qualities of the engine and the condition of the road. There is nothing rythmical, however, in such movements. They follow each other in no regular order, and have no cumulative tendency. Almost suddenly an engine running at forty or fifty miles an hour will cease to jump and pitch and twist. Instead, it acquires a lateral motion right and left, always rythmical, and generally coinciding with one or two revolutions of the driving wheel. The engine takes on itself a sinuous motion, and those on the foot-plate see its head diverge right and left with a curious easy lateral motion, well described as "wandering." If this lasts, the motion continually increases in magnitude just in the same way that the swing of a pendulum augments by small rythmical impulses. If matters are allowed to go on the engine will either leave the metals or burst them. Drivers can stop the thing in a moment by shut ing off steam and putting it on again as quickly as the regulator handle can be moved. This changes the order of the impulses, and steadies the engine; generally, however, matters adjust themselves, any small alteration in the speed at which the train is running, or in the curvature of the road, will upset the order of the derailing impulses and steady the engine. Now, we know that one of the Downton engines was very unsteady, most likely because it was not properly balanced. It is probable that it began wandering and burst the road, which was bent right and left in a way which quite accords with this hypothesis. There is, however, another point worth considering in this connection. The train was running down 1 in 172 when it left the rails, and according to the evidence of a clergyman who was in the train it was travelling at great speed. One of the witnesses estimated the velocity just before the accident occurred at sixty miles an hour. The distance between Downton and Breamoor is three miles, and the run is made in about five minutes. This corresponds to a speed of thirty-six miles an hour, but out of this must be taken say two minutes for getting up speed and slowing down, so that it is not too much to suppose that a speed of at least fifty miles an hour had been attained when the train left the road. It is not at all improbable that the drivers shut off steam just before the catastrophe took place. The engines would then be pressed upon from behind, and this would tend to make them wander more than ever—for shutting off steam altogether is not to be confounded with shutting it off for a revolution or two only. Probably the steam brakes were also applied, and the train then doubled up behind the engines. There is evidence in favour of this supposition. The steam brake is in use on some of the metropolitan trains of the South-Western, and it acts so suddenly and powerfully that trains, even when running at moderate speeds, have the buffers sent clean home to the head, as we have personally observed many times. It is certain that the road was weak. The keys, too, had fallen out of the chairs in several places; and one witness, who sketched the site immediately after the accident, says: "For 30 or 40 yards"—this is just before the train left the rails—"the rails were much twisted and torn from the sleepers. The rails appeared to be *dragged forwards* out of the chairs." Now this dragging forward is exactly what would occur if a very powerful brake were suddenly applied to the wheels of a heavy engine running at speed. We have, then, a combination of conditions. A weak road, to begin with, rendered weaker by the loss of keys; engines swinging heavily; and lastly, the tremendous drag of the steam brakes. It is possible that no two of these conditions would have sufficed to cause the wrecking of the train, but the combination of the three was simply irresistible.

It will be seen that Col. Rich refers to the violent shaking experienced by passengers on the South-Western Railway. We can endorse all that has been said from personal experience, and we have even taken some trouble to arrive at the cause. It will be found that it is the leading coaches in long trains which oscillate most. It is well known that unless drawbars are screwed up tight, so as to make each carriage steady its neighbour, violent oscillation will ensue, even on the best roads. On the London and South-Western Railway very long trains indeed are run; the coaches are nearly all old, and have weak draw and buffer springs. However closely they are screwed up to begin with, the tractive effort of the engines—and two engines are the rule with the heavy trains—will compress the draw springs, and the trains will run with the buffers out of contact. The result is that the passenger carriages run about as steadily as the wagons of a goods train. With the new engines put on the line by Mr. Adams there is no fault to be found; but the permanent way and the rest of the rolling stock are quite unsuitable for a first-class railway. There is no company in England on which such heterogeneous trains can be found as those which leave Waterloo daily. The coaches are all manner of sizes and weights, and the greater number are only suitable for slow branch traffic. At one period the company had the doubtful reputation of running its locomotives more miles in a year than any other in England, with the result that on no railway did the engines break down so often. We fear that the shareholders will have to make up their minds to spend a large sum in the immediate future on the construction of passenger coaches, and in bringing up their road to a proper condition. The Board of Trade think so strongly on this subject that Mr. Calcraft has addressed a special letter to the secretary of the company, drawing attention to Colonel Rich's report, and requesting that he will point out to his directors "the very grave and serious responsibility which will rest upon them if they do not at once take such steps as they may deem necessary to place their stock and permanent way in a safe and efficient condition. The Board of Trade would be glad to learn at an early date that your directors have given the necessary instructions for such reforms in the conduct of their line as will ensure that amount of safety which the travelling public has a right to demand."

Our comments on the Downton catastrophe—we can scarcely call it an accident—would be incomplete if we did not point out that if the train had been fitted with an automatic brake, there would probably not have been one death to deplore. According to the evidence, the engines did not drag the train off the rails. Just as in the case of the Penistone accident, they found the road sound, and they left it a wreck. The pilot engine does not appear to have contributed in any way to the calamity, as both its tender and the train engine kept on the metals. Very early in the sequence of events the engines left the train to its own devices by the breaking of the tie bar. With a Westinghouse or other good automatic brake this would have been followed by the instantaneous application of the blocks to the wheels. There would have been no piling up, no running of one coach on another. As it was, the moment one vehicle left the rails it experienced a resistance to further movement, which the others did not; they rushed upon it, pushed it off the road, and each in turn followed it. This could not have happened to the same degree, or perhaps in any degree, if all the wheels had been locked fast in a moment. It is a noteworthy fact that not one voice has been raised to refute an argument which, not in this journal alone, but in many others, and in Board of Trade reports, has been urged over and over again. The matter cannot be contested, and the time is not far distant now when automatic brakes will be fitted to *all* passenger trains whether the directors like it or not. The cost is supposed to be too great; that is really the only tangible argument that can be raised in this connection. But we suppose that the price which the London and South-Western Railway Company will have to pay for the Downton catastrophe would have sufficed to fit every fast train on the line with an automatic brake.

A CROWDED CITY.

THE inconveniences of an overcrowded city do not in London arise so much from the great and ever increasing population, as from the irregularity of the growth in different districts. In residential London the demand for accommodation creates a supply; new streets and suburbs with local railways afford the necessary relief, and the area yet available is sufficient for many years to come. So also the port of London tends naturally down the river, on whose banks there are still waste lands enough to provide docks and water space for the ships of the world. Manufactures, too, need not be impeded. Much of the river frontage is yet unoccupied, and along each line of railway there are convenient sites adapted for particular trades. It is in the City proper that the congestion of traffic is becoming unbearable, and the remedy is not immediately apparent. There are certain kinds of commerce that must be conducted in the centre of the town. Near the Bank of England must all other Banks be placed, and merchants bid high for offices within the favoured area. Up till the present time the rebuilding and rearrangement of offices have added greatly to the space available, even when allowance is made for that abstracted for new and widened streets. Not only are buildings carried higher, but cellars are taken deeper, and even those two storeys below ground are well lighted and ventilated. But in the streets themselves further improvement according to the present method is becoming more and more difficult, and it may be interesting to consider from an engineer's point of view what new remedies are available or possible in the future. Just as buildings are made higher and deeper than before, so when horizontal extension is hindered by the exigencies of space which not even engineers can overcome, lines of communication above and below ground will have to be constructed. Underground railways have about reached their limit in the City itself, and it is not desirable that the terminal stations should come nearer or encroach still further on the central area. But there is still much to be done by subways for water and gas mains, like those already constructed below Holborn-viaduct and Queen Victoria-street. A few years hence we shall look back with astonishment on the present barbarous custom of burying pipes and telegraphs in the earth, and of stopping periodically the public traffic while trenches are opened and re-filled. Sooner or later elevated railways will be made, and though, according to our English conservatism, much opposition will be encountered, it will at last be overcome by the advantages obtainable. But there is another and a wider field yet open within which the business capacity of the City may be extended, and that is—now that mere space is no longer available—the greater utilisation of time. We venture to think that not many years hence the plethora of street traffic will have to be relieved by the carrying and handling of merchandise during the night, so leaving the street freer during the daytime for the movement of light vehicles and foot-passengers. By the same means, also, warehouses and offices of a certain size would suffice for a larger volume of business, for carriers and porters could use at night the space which clerks and customers occupied by day. To put it shortly, if, owing to the growing concentration of business in the City, the present enormous rents of warehouses and offices have to be paid, while traffic to and fro through crowded streets is rendered slow and costly, how much longer will a day of nine hours suffice? What would be thought of a railway whose goods traffic was to cease as the day closed? and how could dividends on the capital invested be paid out of the earnings of only twelve hours per day? And yet a railway by laying down additional lines and building larger stations, has yet some margin left for space extension, while the City has none. There are but few residents in the City to be annoyed by night work, and what is there to hinder the free movement of merchandise? Day traffic need not be prohibited but might be discouraged, by allowing to railway vans, and all vehicles carrying goods of a certain size and weight, free movement only during the night, and by imposing a toll during the day. Already the police regulate the traffic of certain narrow streets, by permitting vehicles to pass only in one direction; and there is a continual struggle between the frontagers who desire to unload vans and carts at their doors, though they thereby

stop up the street, and the police who seek to keep open these streets to circulation. It is a familiar sight in London to see a long line of vehicles arrested while one van is unloading. The delays so caused have a money value, and sooner or later the privilege of stopping the way will have to be paid for. We do not propound any scheme. Methods and details will be arranged as the evils to be met become more glaring; but if London is to maintain its place as the centre of the business world, some such remedy as we indicate will have to be adopted, and a grand future may open out when this ancient City, moving as it always has done in the van of progress, may, under the illumination of the electric light, and with every other scientific aid, give employment to a double population of busy workers during day and night.

PROSPECTS OF YOUNG ENGINEERS.

In two articles we have endeavoured to set forth the nature of the adverse influences that militate against the prosperity of young mechanical engineers. That we have taken an accurate view of the position seems to be proved by the circumstance that none of our readers have disputed our statements. No sooner had the discussion been opened in our columns by Mr. Audain, than we were overwhelmed with letters on the subject, for the best of which we found space. It was sufficient to point out the nature of the mistakes in education committed by the young man, his parents, or his teachers, to close the correspondence. No one disputes what we have said. No young man has written to say that he knows just what a mechanical engineer ought to know, according to our definition, and yet lacks work. Indeed, none of our correspondents seem to have ever received the special training essential to their success. We desire now to finish what we have to say on this important question, and to put before our readers one or two points which deserve attention. Before proceeding further, however, we would call attention to the letter by "A Young Engineer," which will be found on another page. The indictment which he frames against firms taking pupils is, we have no doubt, based on facts. We do not dispute its accuracy. The whole pith and marrow of what we have written is that the education given to the mechanical engineer is conducted on a wrong system; and we have strongly advised young men for this, among other reasons, to avoid the engineering profession as a means of living. Not only is the supply of imperfectly educated men greatly in excess of the demand, but there is no immediate prospect that there will be better teaching in future. We have no intention of asserting that the deficiences of young engineers are wholly due to themselves. Be they due to what they may, their results are none the less deplorable.

It has often been urged that diplomas should be granted to engineers after they had passed suitable examinations. The work of getting such diplomas would not be easy. Those who had them would be much more likely to get employment than those who had not, and the whole status and position of the profession would be raised. Now it is quite true that much may be said in favour of examinations and diplomas, but we fear that they would in no way help the young mechanical engineer to earn a living. It is often pointed out that the physician and the surgeon must pass examinations before they can practice, but there is no true analogy between the mechanical engineer and the "medical man." The line which a surgeon's examination shall take is clearly mapped out; it cannot be altered. It is intended to test his knowledge of anatomy more than anything else. The examination for the higher degrees deals with other branches of information, such as the properties of drugs, and the diagnosis of disease. The examination of the young engineer may determine what he knows of natural philosophy, mathematics, the properties of materials, and such-like, and even test his skill as a handicraftsman; but these are all secondary instead of primary matters. As we have endeavoured to show in preceding articles, the wages that can be earned by, let us say, a Whitworth scholar, are quite inadequate to the amount of information he has acquired. This must be so, so long as the conditions under which machinery is now made subsist. The object, no doubt, of the young mechanical engineer is to get a post as manager. He can hope for nothing better for many years of his life. For such a berth, a profound knowledge of mathematics would be just as useful as a profound knowledge of Latin. All that has ever been written concerning the theory of the steam engine he might dispense with. The whole of the book learning, in fact, which he will need could be contained in one or two small volumes. But an examination must mainly be based on book learning, and would therefore in his case be wasted. On the other hand, if he is to be a successful man, he should possess a great fund of information which cannot be got from books. If he can speak and write German and French, so as to be quite intelligible, even if not quite grammatical, he will find his knowledge of the greatest value to him. In fact, the young engineer who has not a good colloquial knowledge of these languages in the present day is heavily handicapped in the race for the best berths. We have already spoken concerning drawing, a knowledge of prices, and weights of materials, the management of men, and other matters. Now we ask, is there any examination conducted in Great Britain which can decide the merits in those respects of competing candidates? Not one. We are far from saying that it would be impossible to frame an examination of the kind, but those who would attempt to pass it would be extremely few. To sum up a good deal of what we have already said, the present system of educating young engineers is based on a wholly mistaken notion of what the mechanical engineer must do in order to earn his bread. A few men at the top of the profession are taken as examples; they know certain things; therefore every pupil must learn them. They do not know certain things, consequently the pupil need not learn them. Such is the system; and the result is that hundreds of young men, after wasting the best years of their life, are driven to give up engineering altogether. They emigrate and become farmers; they go into the medical profession; they keep shops. We have heard of two who, joining the remnant of their capital, started a public-house and are doing well. And this all arises from a wholly mistaken and, in one sense, very exaggerated notion of what the duties and functions of the mechanical engineer are. All that we have written is based on the assumption that our young engineer intends to employ himself in making things for sale. Concerning civil engineers—the men who make roads and docks and railways and harbours—or consulting mechanical engineers—who make nothing, save money—we are not speaking at all. Their education must take a totally different direction.

Parents and guardians will do well to think of several things before they make or attempt to make mechanical engineers of their sons. In the first place, the competition is absolutely unlimited, and this in a way which has no parallel in the learned professions. The gentleman apprentice is supposed to learn a great many things. To name only two, he is understood to be a capital draughtsman and a first-rate fitter. As a matter of fact, the two things are incompatible, and no man ever yet met with a first-rate fitter who was also a first-rate draughtsman. The pupil, however, at the end of his five years' apprenticeship finds that Tom, Dick, or Harry—men far below him in the social scale—can beat him with the utmost ease as a fitter; while boys, who hardly know how to spell, are far more skilful than he is in the use of drawing instruments. Thus the gentleman has to compete at every turn with the artisan. They have both to earn their bread in much the same way, but the gentleman pupil is spoiled as a fitter by learning how to draw, and is spoiled as a draughtsman by working at the bench. He is handicapped at the very outset of the race in life, and the competition is, of course, the most severe that it is possible to conceive. Nothing of this kind can assail the young "general practitioner;" it is not possible that he can be beaten in one direction by one specialist and in another by a second, both far below him in the social scale, and educated at a tenth part of the price he has paid for acquiring information. The idea that a young man intended to take charge of works should spend years of his life in learning to use the hammer and chisel and file, is a fossil—a relic of the past. That he should go through the shops is essential, but the two things are wholly different. A case came under our knowledge years ago in which a pupil who had paid a fee of several hundreds of pounds to a first-class firm of mechanical engineers, spent his first three months working a machine screwing bolts, and when he remonstrated, was put for another three months to screw nuts. It is quite out of the question to attempt to describe here fully what the education of the young mechanical engineer should be, but our readers may rest assured that it would have little in common with the system now in use. One effect of it would be to weed out in about the first year the young men who had mistaken their vocation; another would be to teach more that would be subsequently useful for engineering purposes in one year than is now taught in three.

AN INDO-EUROPEAN RAILWAY.

At various times schemes have been proposed for uniting England and India by rail. Of one of these the Channel Tunnel was to form an integral part. For various reasons, political and financial, these schemes have all fallen through. It is now proposed to break ground in a new direction, and instead of taking the north shore of the Mediterranean as the route for an Indo-European line, to take the south shore; in other words, to run the line through North Africa. The route proposed is Paris, Madrid, Gibraltar, Tangiers, Tunis, Tripoli, Cairo, Bassorah, Kelat, to Kurrachee and Bombay. The nominal capital is fixed at £10,000,000, which, of course, would suffice to construct a large portion of the line. It is intended to profit by the existing railways in France and Spain, and to establish a steam transit from the Bay of Gibraltar to Ceuta, in Morocco. From this latter point would begin the International Railway, the works of which in Morocco would have to be constructed. This line would form a junction with the system of railways under French administration in Algeria and Tunisia, giving communication from France to the various lines and branches in these provinces. It is believed that by this section of the line, at all events, much would be gained by the French Government, if only for strategical purposes. It is then proposed to continue the route through Tripoli to form a junction with the Egyptian Railway system. From Egypt the route to India would be continued to reach the Euphrates, and then along the coast of the Persian Gulf to the port of Kurrachee, in India. At this point the great Indian system of railways would be reached, communicating with Bombay, Calcutta, and Madras. The first section of the line in Morocco would be 432 miles long. The company will make arrangements with the Algerian and Tunisian Railway Companies for running powers over their lines, and with such modifications as may be necessary for the through traffic of the company. The preliminary surveys of the line have, we understand, been made by competent engineers, with also estimates of traffic.

COALOWNERS AND COAL-GETTERS.

At Barnsley the other day, Mr. A. M. Chambers, of the Thorncliffe Ironworks and Collieries, stated that one of the most serious difficulties that had to be encountered in the daily working of mines was that of getting properly educated and intelligent men into the positions of managers and deputies and other offices about the mines. It now seemed to be thought that if boys had passed the sixth standard they were too clever to go into the pit. Coalowners must get their workmen to understand that no boy was too clever or too intelligent to go into a coal mine and to qualify himself in taking part in the management of a mine. Mr. Chambers further expressed the opinion that coalowners before many years were passed would find their money was well laid out. Mr. C. E. Rhodes—Aldwarke Main and Car House Collieries—remarked that he believed 80 per cent. of the accidents in mines could be prevented by ordinary care and foresight on the part of the men themselves; in fact, speaking from his own experience, 90 per cent. of the accidents he had to report in the last ten years as fatal and non-fatal accidents would have been prevented had the men carried out the rules which accompanied the Mines' Regulation Act. The great evil which managers had to contend with was the ignorance of the men, who would persist in thwarting the rules if they could thereby see the slightest opportunity of lessening labour on their part.

PORT CHARGES.

We referred some time ago in The Engineer to the unequal incidence of charges on vessels entering and leaving perts at home and abroad. It is satisfactory to notice that in the United States there has been a very considerable reduction in the amount of the port charges. In that country the principle prevailed of having a heavy charge on vessels entering the port for the first time, and of levying no more during the year on that vessel whatever the number of her voyages to the port in that time. It was a method that mulcted the occasional visiting vessel for the benefit of the constant traders. There has been a change that will give some relief to a considerable number of shipowners. Steamers from the 1st of July pay only 6c. per net register ton on the first voyage in a year, whilst previously they paid 30c. per ton. After they have made five trips in a year payment of the 6c. ceases for that year, so that the vessel pays no more than she did, regardless of the number of its voyages, whilst if there are very few voyages the vessel pays less. It is to be hoped that the example that the United States has set may be followed in this country to the extent of a general reduction of the port charges, which seem to have no basis in principle; and which in the present time of dulness in steam shipping form a serious burden on the vessel. A general reduction would materially stimulate the carrying trades just now.

L'ABBE MOIGNO.

We regret having to record the death at St. Denis of Abbé François Napoleon Marie Moigno, in the 81st year of his age. He was born in Brittany, at Guémenée—Morbihan—on the 20th of April, 1804. He was educated at Pontevy, and by the Jesuits of St. Anne d'Auray. He early manifested a strong predilection for science, and especially mathematics. This was not quite what the Jesuit order to which he belonged wanted, and as recently as 1861 he was directed to suspend the publication of a book on the Calculus, and sooner than give way he left the order. His principal works are "Traité de la Télégraphie Electrique;" "Mémoires sur le Stéréoscope et le Saccharimètre;" "Répertoire d'Optique Moderne;" "Cours de Science Vulgarisée;" "Leçons de Mécanique Analytique;" "Les Eclairages Modernes;" many volumes of "Actualités Scientifiques;" and, lastly, "Les Splendeurs de la Foi."

The Abbe Moigno was, to use his own expression, one out of the *piocheurs* of his epoch. The word is untranslatable in his sense. It literally means one who handles a pickaxe. Rising every morning at 5 a.m., he performed his religious duties and then began work, which he did not cease to perform until evening, and he led this life until a very recent period. He was a man of vast erudition and a voluminous writer, having published more than 100 volumes on various scientific subjects, to say nothing of 21 volumes of *Cosmos* and 58 of Les Mondes. He was blessed with an astounding memory, and he was well acquainted with all the usual languages ancient and modern. He invented a curious system of artificial memory called "Mnémotechnie," by the aid of which he held at his disposal a vast number of facts, historical and scientific. It was wonderful to see with what ease he searched his memory for obscure dates or little known scientific facts. The Abbe Moigno's death will leave a blank which will not readily be filled, and he will be regretted by a large circle of literary men and friends.

FOREIGN NOTES.

The Russian Government has decided not to procure either heavy ordnance or field artillery from foreign manufacturers for the future, but rather to supply all their demands for guns from the Obuchoff Works. This establishment is now constructing the 12in. breech-loading guns for the vessels building at St. Petersburg, Nicolajew, and Odessa, and it is confidently expected that these guns will give every satisfaction. In the matter of steel shell the Russians are still, however, dependent on Herr Krupp, who has received orders for very large quantities of the same. The mode in which these shells are manufactured is kept profoundly secret, but it is generally supposed that the powder chamber is forged, and that the principal art lies in the tempering after hardening.

The action pursued by Messrs. Cammell and Co. in removing their rail mills from Sheffield to the coast has created considerable consternation among steel-works owners on the continent. In Germany, especially, the subject has been discussed at various large meetings of engineers, and numerous proposals have been made as to the manner in which German rail makers can best protect their export interests should further English inland firms follow the example of Messrs. Cammell and Co. It is feared, and no doubt with good reason, that in this case continental rails would be debarred from the American and British colonial markets, unless special canal-boat and railway rates are secured in the shape of Government subsidies. A further subject to which foreign firms, chiefly Belgian and German, are directing their attention, is the manufacture of iron sleepers, &c., for the Indian States Railways, and it is anticipated that heavy orders will shortly be secured by them, as but few English firms appear to be inclined to tender for such material.

The latest addition to the Italian ironclad navy, the Ruggiero di Lauria, was launched at Castellamare on the 9th ult. This vessel forms one of the Andrea Doria class, and is a modified type of the Italia. She is constructed entirely of steel, and her principal dimensions are:—Length between perpendiculars, 328ft. 1in.; extreme breadth of beam, 65ft. 7in.; mean draught of water, 25ft. 6in.; displacement, 10,080 tons. Her twin-screw engines, of 10,000 indicated horse-power, have been supplied by Messrs. John Elder and Co., of Glasgow, and are estimated to propel her at a speed of sixteen knots per hour. The chief armament of the Ruggiero di Lauria will consist of four 17in. Armstrong breech-loading guns of the latest design, mounted *en barbette*, and she will likewise be provided with the most modern type of torpedo apparatus and machine guns. The most vulnerable parts of the hull will be protected by 17¾in. armour, the system of which, viz., steel or compound, does not appear to have been decided upon as yet. The only explanation which can be found for this is that various conflicting interests are at work at the naval headquarters for the purpose of mere political opposition, and we therefore find Italy expending enormous sums on competitive armour-plate trials, re-occurring with every change of ministry, whilst the question of the comparative value of the different systems of armour has long been settled by every other naval power.

The Emperor of Germany has authorised the formation at Kiel of a torpedo boat flotilla, for the purpose of testing the qualities of a number of such craft constructed for competitive trial by certain of the best known English and continental builders. This flotilla, which will be under the command of Captain Tirpitz, assisted by the officers of the torpedo school-

ship Blücher, will be composed of fourteen boats, viz., six built by the Vulcan Company, Stettin; six by Herr Schichau, Elbing; and two by Messrs. Thornycroft and Co., Chiswick. A few unofficial trials of the different boats have already taken place; but it would be premature to attempt to arrive at any conclusion as to the relative merits of the various designs until they have been tested by official trials. It may, however, be remarked that while the high-class workmanship exhibited by Messrs. Thornycroft's boats is much praised, the smaller craft, a second-class boat, is reported to be unseaworthy, and consequently unfit for the service for which she is intended. A large torpedo boat of 75 tons, built by Herrr Schichau, lately met with a serious mishap whilst under trial, as the rudder was much bent and the boat had to be conveyed back to Elbing for repairs. The most interesting stage of the official trials will be reached when the boats at present building by the Weser Company, Bremen, and by Messrs. Yarrow and Co., London, are ready to participate in the same. The arrival of a sea-going torpedo boat of the largest size, to be supplied by the last-named firm, is being looked forward to with special interest, as this vessel will, it is expected, be regarded as the standard by which the qualities of the other boats will be gauged.

PETROLEUM REFUSE AS FUEL IN LOCOMOTIVE ENGINES.*

By Mr. Thomas Urquhart.

Comparing naphtha refuse and anthracite, the former has a theoretical evaporative power of 16·2 lb. of water per lb. of fuel, and the latter of 12·2 lb., at a pressure of 8 atm. or 120 lb. per square inch; hence petroleum has, weight for weight, 33 per cent. higher evaporative value than anthracite. Now in locomotive practice a mean evaporation of from 7 lb. to 7½ lb. of water per lb. of anthracite is about what is generally obtained, thus giving about 60 per cent. of efficiency, while 40 per cent. of the heating power is unavoidably lost. But with petroleum an evaporation of 12·25 lb. is practically obtained, giving $\frac{12{\cdot}25}{16{\cdot}2} = 75$ per cent. efficiency. Thus in the first place petroleum is theoretically 33 per cent. superior to anthracite in evaporative power; and secondly, its useful effect is 25 per cent. greater, being 75 per cent. instead of 60 per cent.; while thirdly, weight for weight, the practical evaporative value of petroleum must be reckoned as at least from $\frac{12{\cdot}25 - 7{\cdot}50}{7{\cdot}50} = 63$ per cent. to $\frac{12{\cdot}25 - 7{\cdot}00}{7{\cdot}00} = 75$ per cent. higher than that of anthracite.

Spray injector.—Steam, not superheated, being the most convenient for injecting the spray of liquid fuel into the furnace, it remains to be proved how far superheated steam or compressed air is really superior to ordinary saturated steam, taken from the highest point inside the boiler by a special internal pipe. In using several systems of spray injectors for locomotives, the author invariably noticed the impossibility of preventing leakage of tubes, accumulation of soot, and inequality of heating of the fire-box. The work of a locomotive boiler is very different from that of a marine or stationary boiler, owing to the frequent changes of gradient on the line, and the frequent stoppages at stations. These conditions render firing with petroleum very difficult; and were it not for the part played by properly arranged brickwork inside the fire-box, the spray jet alone would be quite inadequate. Hitherto the efforts of engineers have been mainly directed towards arriving at the best kind of "spray injector," for so minutely subdividing a jet of petroleum into a fine spray, by the aid of steam or compressed air, as to render it inflammable and of easy ignition. For this object nearly all the known spray injectors have very long and narrow orifices for petroleum as well as for steam; the width of the orifices does not exceed from ½ mm. to 2 mm., or 0·02in. to 0·08in., and in many instances is capable of adjustment. With such narrow orifices it is clear that any small solid particles which may find their way into the spray injector along with the petroleum will foul the nozzle and check the fire. Hence in many of the steamboats on the Caspian Sea, although a single spray injector suffices for one furnace, two are used, in order that when one gets fouled the other may still work; but, of course, the fouled orifices require incessant cleaning out.

Locomotives.—In arranging a locomotive for burning petroleum, several details are required to be added in order to render the application convenient. In the first place, for getting up steam to begin with, a gas pipe of 1in. internal diameter is fixed along the outside of the boiler, and at about the middle of its length it is fitted with a three-way cock having a screw nipple and cap. The front end of the longitudinal pipe is connected to the blower in the chimney, and the back end is attached to the spray injector. Then by connecting to the nipple a pipe from a shunting locomotive under steam, the spray jet is immediately started by the borrowed steam, by which at the same time a draught is also maintained in the chimney. In a fully equipped engine-shed the borrowed steam would be obtained from a fixed boiler conveniently placed and specially arranged for the purpose of raising steam. In practice steam can be raised from cold water to 3 atm. pressure—45 lb. per square inch—in twenty minutes. The use of auxiliary steam is then dispensed with, and the spray jet is worked by steam from its own boiler; a pressure of 8 atm.—120 lb.—is thus obtained in fifty to fifty-five minutes from the time the spray jet was first started. In daily practice, when it is only necessary to raise steam in boilers already full of hot water, the full pressure of 7 to 8 atm. is obtained in from twenty to twenty-five minutes. While experimenting with liquid fuel for locomotives, a separate tank was placed on the tender for carrying the petroleum, having a capacity of about 3 tons. But to have a separate tank on the tender, even though fixed in place, would be a source of danger from the possibility of its moving forwards in case of collision. It was therefore decided, as soon as petroleum firing was permanently introduced, to place the tank for fuel in the tender between the two side compartments of the water tank utilising the original coal space. For a six-wheeled locomotive the capacity of the tank is 3½ tons of oil—a quantity sufficient for 250 miles, with a train of 480 tons gross, exclusive of engine and tender. In charging the tender tank with petroleum it is of great importance to have strainers of wire cloth in the manhole of two different meshes, the outer one having openings, say, of ¾in., the inner, say, of ½in.; these strainers are occasionally taken out and cleaned. If care be taken to prevent any solid particles from entering with the petroleum, no fouling of the spray injector is likely to occur; and even if an obstruction should arise, the obstacle, being of small size, can easily be blown through by screwing back the steam cone in the spray injector far enough to let the solid particles pass and be blown out into the fire-box by the steam. This expedient is easily resorted to even when running; and no more inconvenience arises than an extra puff of dense smoke for a moment, in consequence of the sudden admission of too much fuel. Besides the two strainers in the manhole of the petroleum tank on the tender, there should be another strainer at the outlet valve inside the tank, having a mesh of ⅛in. holes.

Driving Locomotives.—In lighting up, certain precise rules have to be followed, in order to prevent explosion of any gas that may have accumulated in the fire-box. Such explosions do often take place through negligence; but they amount simply to a puff of gas, driving smoke out through the ash-pan dampers, without any disagreeably loud report. This is all prevented by adhering to the following simple rules:—First clear the spray nozzle of water by letting a small quantity of steam blow through, with the ash-pan doors open; at the same time start the blower in the chimney for a few seconds, and the gas, if any, will be immediately drawn up the chimney. Next place on the bottom of the combustion chamber a piece of cotton waste, or a handful of shavings, saturated with petroleum and burning with a flame. Then by opening first the steam valve of the spray injector, and next the petroleum valve gently, the very first spray of oil coming on the flaming waste immediately ignites without any explosion whatever; after which the quantity of fuel can be increased at pleasure. By looking at the top of the chimney, the supply of petroleum can be regulated by observing the smoke. The general rule is to allow a transparent light smoke to escape, thus showing that neither too much air is being admitted nor too little. The combustion is quite under the control of the driver, and the regulation can be so effected as to prevent smoke altogether. While running, it is indispensable that the driver and fireman should act together, the latter having at his side of the engine the four handles for regulating the fire, namely, the steam wheel and the petroleum wheel for the spray injector, and the two ash-pan door handles in which there are notches for regulating the air admission. Each alteration in the position of the reversing lever or screw, as well as in the degree of opening of the steam regulator or the blast pipe, requires a corresponding alteration of the fire. Generally the driver passes the word when he intends shutting off steam, so that the alteration in the firing can be effected before the steam is actually shut off; and in this way the regulation of the fire and that of the steam are virtually done together. All this care is necessary to prevent smoke, which is nothing less than a waste of fuel. When, for instance, the train arrives at the top of a bank, which it has to go down with the brakes on, exactly at the moment of the driver shutting off the steam and shifting the reversing lever into full forward gear, the petroleum and steam are shut off from the spray injector, the ashpan doors are closed, and if the incline be a long one, the revolving iron damper over the chimney top is moved into position, closing the chimney, though not hermetically. The accumulated heat is thereby retained in the firebox; and the steam even rises in pressure, from the action of the accumulated heat alone. As soon as the train reaches the bottom of the incline and steam is again required, the first thing done is to uncover the chimney top; then the steam is turned on to the spray injector, and next a small quantity of petroleum is admitted, but without opening the ash pan doors, a small fire being rendered possible by the entrance of air around the spray injector, as well as by possible leakage past the ash pan doors. The spray immediately on coming in contact with the hot chamber ignites without any audible explosion; and the ash pan doors are finally opened, when considerable power is required, or when the air otherwise admitted is not sufficient to support complete combustion. By looking at the fire through the sight-hole it can always be seen at night whether the fire is white or dusky; in fact, with altogether inexperienced men it was found that after a few trips they could become quite expert in firing with petroleum. The better men contrive to burn less fuel than others, simply by greater care in attending to all the points essential to success. At present seventy-two locomotives are running with petroleum firing; ten of them are passenger engines, seventeen are eight-wheel coupled goods engines, and forty-five are six-wheel coupled. As might be expected, several points have arisen which must be dealt with in order to ensure success. For instance, the distance ring between the plates around the firing door is apt to leak, in consequence of the intense heat driven against it, and the absence of water circulation; it is therefore either protected by having the brick arch built up against it, or, better still, it is taken out altogether when the engines are in for repairs, and a flanged joint is substituted, similar to what is now used in the engines of the London and North-Western Railway. This arrangement gives better results, and occasions no trouble whatever.

Storage of petroleum.—The length of line now worked with petroleum is from Tsaritsin to Burnack, 291 miles. There is a main iron reservoir for petroleum at each of the four engine sheds, namely, at Tsaritsin, Archeda, Filonoff, and Borisoglebsk. Each reservoir is 66ft. internal diameter and 24ft. high, and when full holds about 2050 tons. The method of charging the reservoir, which stands a good way from the line, and is situated at a convenient distance from all dwelling houses and buildings, is as follows:—On a siding specially prepared for the purpose are placed ten cistern cars full of oil, the capacity of each being about 10 tons. From each of these cars a connection is made by a flexible india-rubber pipe to one of ten stand-pipes which project 1ft. above the ground line. Parallel with the rails is laid a main pipe, with which the ten stand pipes are all connected, thus forming one general suction main. About the middle of the length of the main, which is laid underground and covered with sawdust or other non-conducting material, is fixed a Blake steam pump. As soon as all the ten connections are made with the cistern cars, the pump is set to work, and in about one hour the whole of the cars are discharged into the main reservoir, the time depending of course upon the capacity of the pump. All the pipes used are of malleable iron, lap-welded and of 5in. internal diameter, having screwed coupling muffs for making the connections. At each engine shed, in addition to the main storage reservoir, there is a smaller distributing tank, which is erected at a sufficient height to supply the tenders, and very much resembles the ordinary water tanks. These distributing tanks are circular, about 8½ft. diameter and 6ft. high, and of ¼in. plates; their inside mean area is calculated exactly, and a scale graduated in inches stands in the middle of the tank; a glass with scale is used outside in summer time. Each inch in height on the scale is converted into cubic feet, and then by means of a table is converted into Russian poods, according to the specific gravity at various temperatures. As it would be superfluous to graduate the table for each separate degree of temperature, the columns in the table show the weights for every eight degrees Réaumur, which is quite sufficient:—Namely, from 24 deg. to 17 deg., from 16 deg. to 9 deg., and so on, down to – 24 deg.; the equivalent Fahrenheit range being from 86 deg. down to – 22 deg. Suppose the filling of a tender tank draws off a height of 27in. from the distributing tank, at a temperature of, say, – 20 deg. R., these figures are shown by the table to correspond with 200·61 poods = 7245 lb., or 3·23 tons of petroleum. This arrangement does very well in practice; both the quantity and the temperature are entered on the driver's fuel bill at the time of his taking in his supply.

Engines.—The engines used in the trials were built by Borsig, of Berlin, Schneider, of Creusot, and the Russian Mechanical and Mining Company of St. Petersburg. Their main dimensions and weights were about the same, as follows, all of them having six wheels coupled, and 36 tons adhesive weight; as originally constructed they had ordinary fire-boxes for burning anthracite or wood:—Cylinders, 18½in. diameter and 24in. stroke; slide valves, outside lap 1$\frac{1}{16}$in., inside lap $\frac{1}{32}$in., maximum travel, 4$\frac{3}{16}$in.; Stephenson link motion; boiler pressure, 120 lb. per square inch; six wheels, all coupled, 4ft. 3in. diameter; distance between centres of leading and middle wheels, 6ft. 2$\frac{3}{4}$in.; between middle and trailing, 4ft. 9½in.; total length of wheel base, 11ft.; weight empty, on leading wheels, 12·041 tons; middle, 10·782 tons; trailing, 10·685 tons; total weight, 33·508 tons empty; weight in running order, on leading wheels, 12·563 tons; middle, 11·885 tons; trailing, 12·790 tons; total weight, 37·238 tons in running order. Tubes, number, 151; outside diameter, 2⅛in.; length between tube plates, 13ft. 10$\frac{1}{8}$in.; outside heating surface, 1166 square feet; fire box heating surface, 82 square feet; total heating surface, 1248 square feet; fire-grate area, 17 square feet; tractive power = 65 per cent. of boiler pressure $\times \frac{(\text{cyl. diam.})^2 \times \text{stroke}}{\text{diameter of wheels}} = 0{\cdot}65 \times 120 \times \frac{(18{\cdot}125)^2 \times 24}{51} = 5{\cdot}383$ tons. Ratio of tractive power to adhesion weight $= \frac{5{\cdot}383}{37{\cdot}238} = \frac{1}{6{\cdot}9}$.

Tender.—Contents; water, 310 cubic feet or 1933 gallons or 8½ tons; anthracite, 600 poods or 10 tons; or wood, 1½ cubic sajene, or 514 cubic feet; weight empty, 13·477 tons; weight in running order, 28·665 tons; six wheels.

The accompanying table shows the results of comparative trials made in winter with different sorts of fuel, under exactly similar conditions as to type of engine, profile of line, and load of train. Two sets of comparative trials were made, both of them in winter. The three engines used were some of those built by Schneider. In comparison with anthracite, the economy in favour of petroleum refuse was 41 per cent. in weight and 55 per cent. in cost. With bituminous coal there was a difference of 49 per cent. in favour of petroleum as to weight and 61 per cent. as to cost. As compared with wood, petroleum was 50 per cent. cheaper. At a speed of fourteen miles an hour up an incline of 1 in 125 the steam pressure was easily kept up at 9 to 9½ atm. with a No. 9 injector feeding the boiler all the time.

Petroleum Refuse.—Comparative Trials with Petroleum, Anthracite, Bituminous Coal, and Wood, between Archeda and Tsaritsin on Grazi and Tsaritsin Railway, in Winter time.

Date, 1883.	Locomotive.	Train.	Train alone. Number of loaded cars.	Train alone. Gross load.	Distance run.	Car-miles.	Fuel.	Consumption, including lighting up. Total.	Consumption, including lighting up. Per train-mile.	Cost of fuel per train-mile.	Atmospheric temperature, and weather.
			No.	Tons.	Miles.					Pence.	
Feb. 8	8	32—23 / 32—23	25	400	388	9700	Anthracite	31,779 lb.	81·90 lb.	11·957	– 17° to – 18° Réau. equivalent to – 6° to – 8½° Fahr.
	14	24—21 / 24—21	25	400	388	9700	Bituminous coal	37,557·5 lb.	96·53 lb.	14·093	
	7	26—29	25	400	194	4850	Petroleum refuse	9,462 lb.	48·77 lb.	5·487	Strong side wind.
March 6	24	32—23	25	400	194	4850	Anthracite	12,639·5 lb.	65·15 lb.	9·512	– 5° to – 9° Réau. equivalent to 21° to 12° Fahr.
	21	24—21	25	400	194	4850	Wood, in billets	1,071·8 c. ft.	5·52 c. ft.	8·5	
	23	26—27	25	400	194	4850	Petroleum refuse	7,223 lb.	37·23 lb.	4·188	Light side wind.

Prices of fuel:—Petroleum refuse, 21s. per ton; anthracite and bituminous coal, 27s. 3d. per ton; wood, in billets, 42s. per cubic sajene = 343 cubic feet; equivalent to 1·47d. per cubic foot.
Dimensions of locomotives:—Cylinders, 18½in. diam. and 24in. stroke; wheels, 4ft. 3in. diam.; total heating surface, 1248 sq. ft.; total adhesion weight, 36 tons; boiler pressure, 8 to 9 atm.

Up to the present time the author has altered seventy-two locomotives to burn petroleum; and from his own personal observations made on the foot-plate with considerable frost he is satisfied that no other fuel can compare with petroleum either for locomotives or for other purposes. In illustration of its safety in case of accident, a photograph was exhibited of an accident that occurred on the author's line on 30th December, 1883, when a locomotive fired with petroleum ran down the side of an embankment, taking the train after it; no explosion or conflagration of any kind took place under such trying circumstances, thus affording some proof of the safety of the petroleum refuse in this mode of firing. Although it is scarcely possible that petroleum firing will ever be of use for locomotives on the ordinary railways of coal-bearing England, yet the author is convinced that, even in such a country, its employment would be an enormous boon on underground lines.

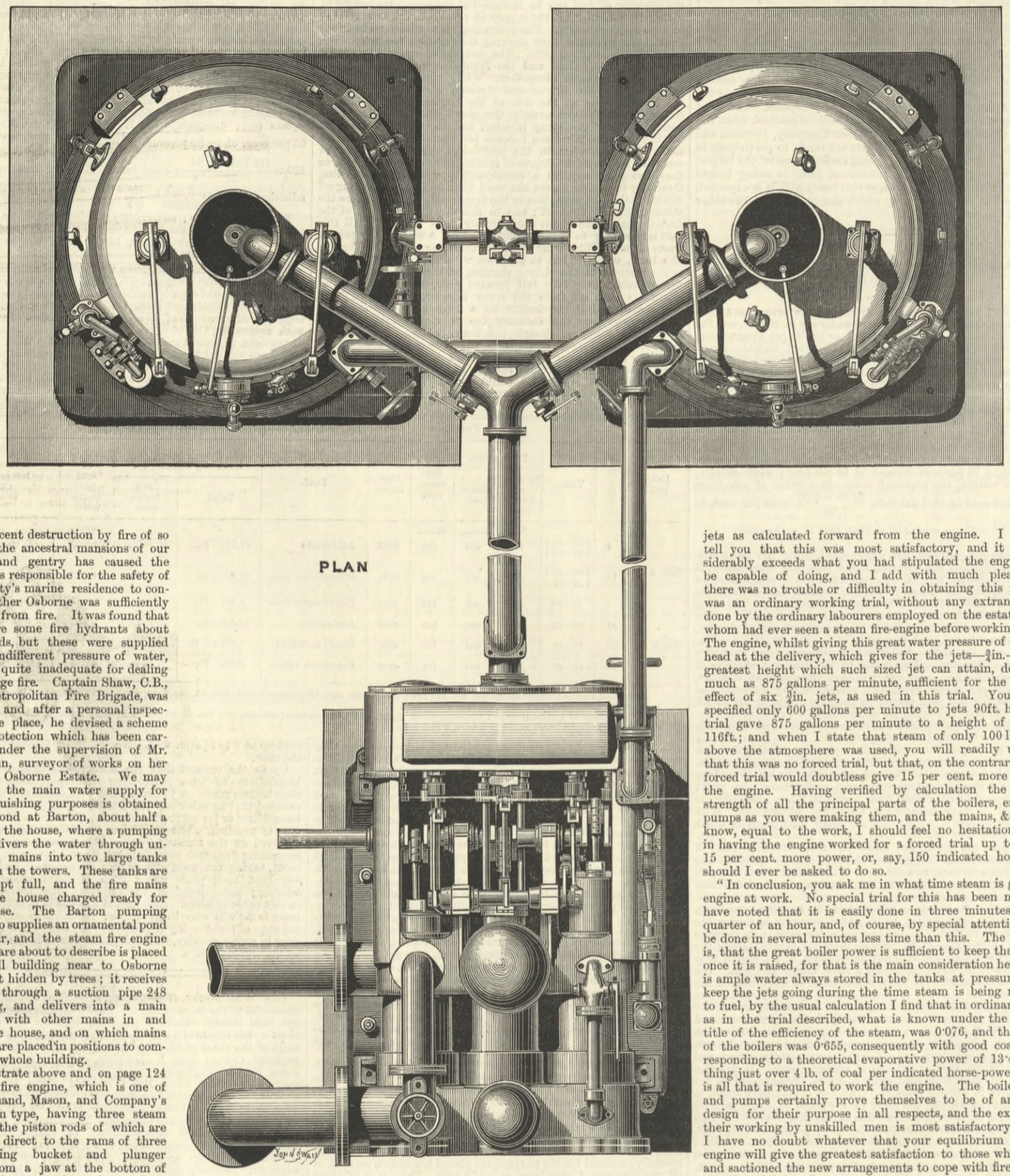
* Abstract of paper read before the Institution of Mechanical Engineers.

The Whitworth Scholarships. — The list of candidates successful in the competition for the Whitworth scholarships, 1884, has been issued:—Richard Stanfield, engineer apprentice, Manchester, has obtained a scholarship of the value of £200. Scholarships of the value of £150 have been awarded to William Sackville, engineer, Crewe; Tom H. Denning, engineer apprentice, Crewe; John Reeves, engineer, Crewe; André P. Griffiths, engineer apprentice, Ebbw Vale, Mon.; Richard North, engineer, Manchester; George Coates, engineering draughtsman, Full Sutton, near York; Andrew C. Shaw, engineer, Glasgow; and J. Kerr Reid, mechanical draughtsman, Glasgow. The following have obtained scholarships of £100 each:—Robert L. Clarke, draughtsman, Plumstead; John Kemp, engineer apprentice, Glasgow; Thomas A. Peace, engineer apprentice, Manchester; George A. Shaw, engineer, London; Albert E. Wolstencroft, joiner, Oldham; William A. E. Crombie, marine engineer, Glasgow; John Sharp, draughtsman, Glasgow; Henry J. R. Burstall, engineer, London; Edwin Baggs, engineer student, Bristol; William J. Caiger, engineer, London; Edward Gardner, engineer, Manchester; James Nixon, engineer apprentice, Newcastle-on-Tyne; John Dougan, engineer, Glasgow; Herbert B. Gregson, engineer, Sidcup; James Tasker, draughtsman, Accrington; and Frank Brown, draughtsman, Plumstead.

Royal Scotch Show.—The Highland and Agricultural Society of Scotland held their annual meeting at Edinburgh from Tuesday to Friday of the last week of July, and this being the centenary year, the show was in all respects the largest and most successful ever held in Scotland. In extent this meeting was second only to that of the Royal Agricultural Society of England. Taking the stock all round, there has never before been such good quality exhibited in one showyard on the northern side of the border. Premiums to the amount of £3953 12s. were offered. In the implement and machinery department all the leading English and Scotch manufacturers exhibited. The entries were above the average number. Several premiums were given in this class, and there being a want amongst the farmers of the North of a thoroughly efficient grain and seed dressing machine, the society offered a first prize of £10 and a second of £5 for the best machines to separate grain and seeds from weeds within the means of an ordinary farmer's acquisition. The trials took place on Wednesday and Thursday on the show ground. Sixteen machines, by various makers, were entered to compete for these, the largest prizes offered for these machines since 1872, and amongst them were those of Mr. Thomas Corbett, of the Perseverance Ironworks, Shrewsbury, who exhibited his Eclipse winnower, constructed on a new principle, which he has recently patented, and which was exhibited for the first time. After exhaustive trials with wheat, oats, barley, and turnip and Italian rye grass seeds, the judges awarded the first prize of £10 to the new machine manufactured by Mr. Thomas Corbett, whose grain dressing machines have now gained every first prize for which they have competed, in the United Kingdom, since 1873.

STEAM FIRE ENGINE, OSBORNE HOUSE.

MESSRS. SHAND, MASON, AND CO., LONDON, ENGINEERS.



PLAN

The recent destruction by fire of so many of the ancestral mansions of our nobility and gentry has caused the authorities responsible for the safety of her Majesty's marine residence to consider whether Osborne was sufficiently protected from fire. It was found that there were some fire hydrants about the grounds, but these were supplied with an indifferent pressure of water, and were quite inadequate for dealing with a large fire. Captain Shaw, C.B., of the Metropolitan Fire Brigade, was consulted, and after a personal inspection of the place, he devised a scheme for its protection which has been carried out under the supervision of Mr. J. K. Mann, surveyor of works on her Majesty's Osborne Estate. We may state that the main water supply for fire extinguishing purposes is obtained from a pond at Barton, about half a mile from the house, where a pumping station delivers the water through underground mains into two large tanks situated in the towers. These tanks are always kept full, and the fire mains within the house charged ready for instant use. The Barton pumping station also supplies an ornamental pond or reservoir, and the steam fire engine which we are about to describe is placed in a small building near to Osborne House, but hidden by trees; it receives its water through a suction pipe 248 yards long, and delivers into a main connected with other mains in and around the house, and on which mains hydrants are placed in positions to command the whole building.

We illustrate above and on page 124 the steam fire engine, which is one of Messrs. Shand, Mason, and Company's equilibrium type, having three steam cylinders, the piston rods of which are connected direct to the rams of three double-acting bucket and plunger pumps; from a jaw at the bottom of each ram the connecting rod extends to the pin of a three-throw crank; the slide valves are worked by a simple arrangement of levers, each cylinder working the valve of the adjacent one. There are two of Messrs. Shand, Mason, and Company's inclined water-tube boilers, specially adapted for raising steam quickly, each capable of supplying sufficient steam to drive the engine at full speed. The steam exhaust and feed pipes, &c., are so arranged that either boiler can be used separately or both in unison. We subjoin a letter from Mr. Mann, giving his own, and not the makers', test of the steam fire engine; and it must be a source of general satisfaction to be thus assured that everything has been done that is possible to protect Osborne in the event of an outbreak of fire, and it would be well that many other noble mansions, with their historical associations and their stores of art treasures, were equally well protected.

Mr. Mann, writing from Osborne, says:—"You ask me, now that the suction is connected and furnishing an adequate supply of water, to furnish you with the results obtained with the new fixed steam fire-engine you have just fixed here. I have great pleasure in doing so, the more especially as the work the engine does very considerably exceeds the stipulations of your contract. I will refer to a trial made on the 9th May, as it was the one most carefully observed. By calculation, your engine, under the conditions of that trial, worked up to just 130 indicated horse-power—that is the power put into the pistons for transmission was 130-horse power—and the calculation of the actual work done thereby exactly accords with this.

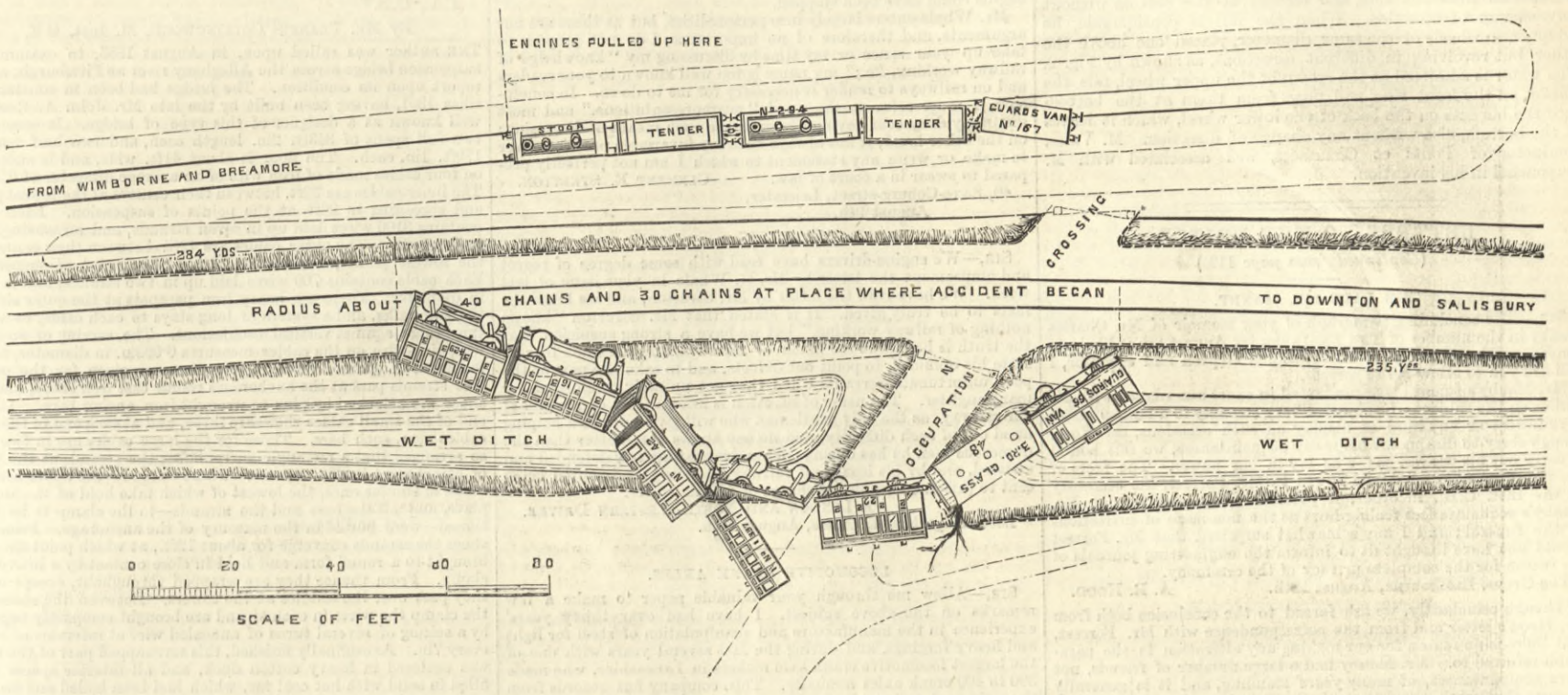
"I would note that the reservoir that supplies the water to the engine is situated at a considerable distance, so that the suction is 248 yards in length, being 10in. in diameter for 168 yards, and 8in. for 80 yards; and the mains that deliver the water from the engine to the twenty-two hydrants in and around the house, and to the fire tanks, are in length about 600 yards. These mains vary in diameter as required, from 7in. at the engine to 3in. at the furthest point. The fire tanks, which are placed close under the roof, hold always upwards of 8000 gallons of water, for use solely for fire purposes; and now as to the work done by the engine in this trial. By detail calculation, 44 of the 130-H.P. would be absorbed in the engine and pumps, leaving just two-thirds, or 86-H.P. to be put into the mains. This is a very satisfactory percentage, and it was verified by the pressure gauge and rate of flow at the entrance to the mains, showing that this was the actual amount of power put into the mains. I should here state, that to test the delivery or rate of flow, the pumps were tested for slip by counting the number of revolutions, and by measuring the quantity of water actually delivered into the large fire tanks, and to my surprise the amount of slip was shown to be practically nothing. The half volume swept by the pump buckets therefore gave the quantity of water delivered.

"Returning to the work done, there was, as previously stated, 86-horse power delivered by the engine into the mains, and detail calculation shows that the friction in the mains, hydrants, and hose would absorb 12-horse power of this, leaving 74-horse power for use at the jets; and as $\frac{3}{4}$in. jets would as a rule be used here, the actual work done, or power given, at the jets was tested by attaching six of the $\frac{3}{4}$in. jets by hose to various hydrants along the length of the mains, and the height the water was thrown to by these was measured at the jet furthest away from the engine which played on to the Flag Tower, where the height it attained could be accurately measured. The actual height water was thrown was right up to the top of the flagstaff, thus attaining a height of 116ft. above the ground where the jet was held; some of the water passed several feet clear over the top of the flagstaff. From this the work thus done by the six jets, as you will find by calculation, was 74-horse power, agreeing exactly with the power delivered at the jets as calculated forward from the engine. I need not tell you that this was most satisfactory, and it very considerably exceeds what you had stipulated the engine should be capable of doing, and I add with much pleasure, that there was no trouble or difficulty in obtaining this result. It was an ordinary working trial, without any extraneous help, done by the ordinary labourers employed on the estate, none of whom had ever seen a steam fire-engine before working this one. The engine, whilst giving this great water pressure of over 300ft. head at the delivery, which gives for the jets—$\frac{3}{4}$in.—used the greatest height which such sized jet can attain, delivered as much as 875 gallons per minute, sufficient for the maximum effect of six $\frac{3}{4}$in. jets, as used in this trial. Your contract specified only 600 gallons per minute to jets 90ft. high. This trial gave 875 gallons per minute to a height of practically 116ft.; and when I state that steam of only 100 lb. pressure above the atmosphere was used, you will readily understand that this was no forced trial, but that, on the contrary, a skilled forced trial would doubtless give 15 per cent. more work from the engine. Having verified by calculation the abundant strength of all the principal parts of the boilers, engine, and pumps as you were making them, and the mains, &c., being, I know, equal to the work, I should feel no hesitation whatever in having the engine worked for a forced trial up to, at least, 15 per cent. more power, or, say, 150 indicated horse power, should I ever be asked to do so.

"In conclusion, you ask me in what time steam is got up and engine at work. No special trial for this has been made, but I have noted that it is easily done in three minutes under the quarter of an hour, and, of course, by special attention it could be done in several minutes less time than this. The main point is, that the great boiler power is sufficient to keep the power up once it is raised, for that is the main consideration here, as there is ample water always stored in the tanks at pressure that will keep the jets going during the time steam is being raised. As to fuel, by the usual calculation I find that in ordinary working, as in the trial described, what is known under the misleading title of the efficiency of the steam, was 0·076, and the efficiency of the boilers was 0·655, consequently with good coal, say, corresponding to a theoretical evaporative power of 13·4 lb., something just over 4 lb. of coal per indicated horse-power per hour is all that is required to work the engine. The boilers, engine, and pumps certainly prove themselves to be of an excellent design for their purpose in all respects, and the experience of their working by unskilled men is most satisfactory; in short, I have no doubt whatever that your equilibrium steam fire-engine will give the greatest satisfaction to those who approved and sactioned the new arrangements to cope with fire now completed at Osborne."

Transatlantic Trade by Hudson's Bay.—The expedition for the exploration of Hudson's Bay, with a view to the establishment of a direct line of traffic between the British north-western colonies and Liverpool, has just sailed from Halifax. A record of the opening and closing of navigation at York Factory, on this icy Mediterranean, prepared by Mr. W. Woods, of the Hudson's Bay Company, shows that during the years from 1828 to 1880 it was never closed later in the spring than June 1st, and was always open as late in the fall as November 3rd, while the earliest opening was May and the latest closing was December 9th. If this were all, the navigability of the proposed new route to Europe would be established, but Hudson Strait, by which the Bay is entered, is known to be impassable except in a part of the month of July, August, and part of September. The immense value of an outlet for the grain trade of Manitoba to Europe by sea, with no railroad except a short line to York Factory, is so obvious that the wonder is that the practicability of the scheme has not been already fully tested. As to its result we are not wholly left to conjecture. During the perilous voyage of Her Majesty's ship Terror, under Captain—afterwards Admiral—Sir George Buck, through Hudson Strait in 1836-37, hourly meteorologial observations were made and careful records of the state of the ice. In January the temperature fell to 54 deg. below zero. But even in August the Terror had very difficult navigation. On five days in that month her log records "boring through the ice." On August 2nd she encountered a "solid pack 20ft. high" and "very heavy ice floes," while an occasional whirlpool or ripple rendered the ship "perfectly unmanageable." A nautical record for July 13th, 1746, in Hudson Strait, mentions an "abundance of low ice five to ten fathoms thick." Such facts are not very encouraging to the Canadian projectors of the new steamer route from York Factory to Liverpool. It is possible, however, that a comparatively ice-free channel leading into Hudson's Bay may be found, and that for six or eight weeks in the year a fleet of grain ships, constructed to stand moderate ice pressure, might safely run the risks.—*New York Herald.*

THE RAILWAY CATASTROPHE AT DOWNTON.



THE report of Col. Rich to the Board of Trade on the Downton derailment has just been published. We give above a sketch taken from the report, showing the position of the vehicles after the event, and we append Col. Rich's conclusions on the matter.

Before recording my opinion as to what caused this disastrous accident, it appears to me desirable to consider the opinion of the chief locomotive engineer of the company, as given to the coroner. He was on the spot the day after it occurred, and before any of the wrecked train or damaged permanent way materials had been removed. Mr. Adams considers that the accident was caused by the breaking of the coupling between the front van, No. 167, and the carriage next to it, No. 429. The van was thrown or pulled off the rails, but it remained attached to the tenders and engines until they were stopped. The coach next to it was pulled up on the north side of the railway bank, about 250 yards behind the van, with its leading end foul of the rails on which it had been running, and with all the other coaches of the train close behind it, in the wet ditch or in the field at the north side of the railway bank. If the coupling had caused the accident, which commenced where the sleepers were first moved in their beds, about 217 yards on the Downton side of where No. 429 coach came to a stand, I am at a loss to think why the tender of the second engine and the brake van behind it should have left the rails. Certainly the coupling breaking could not have pulled them off the rails. Again, as the coupling, if it caused the accident, must have broken just as the coach was on the second curve, which bends to the north, this coach must have gone off to the south on the outside of this curve, and more particularly so, as there was no strain on the outer or off-side chain coupling, which became unhooked. After the centre coupling broke, the strain came on the near side chain coupling and broke it. This would also have had a tendency to send the coach off on the outside of the curve, but it came inwards. The manner in which the centre coupling was broken at the weld showed torsion, and the breakage of the inside chain coupling showed that No. 429 coach had been pulling in a zigzag direction, with van No. 167, when the side chain coupling gave way.

Thirdly, No. 429 coach must have been pulled down the bank into the field, along with the other coaches, if its front coupling had been the first thing to break and cause the disaster. I think that the circumstances attending the accident do not bear out this theory, and I have no hesitation in stating that the accident was caused by the train having been run at too great speed over a weak road. The train having two engines and eight short vehicles, with short wheel bases, was not calculated to run steadily, at great speed, over a line of such gradients and curves. As regards the evidence of the engine drivers and firemen, it will not stand sifting, and I do not think that it can be depended on. They stated that they did not know that anything was wrong, until they reached the cast iron girder bridge, which was more than 200 yards from the place where the first disturbance of the sleepers occurred, and the driver of the second engine stated that he believed that the tender of his engine left the rails when it was about 50 yards from the place where the engine was stopped.

These sleepers were disturbed by oscillation, which was not sufficient to bend the rails for the first forty yards; but, after that, the rails were severely bent outwards alternately to the right and to the left, until some vehicle, probably the third from the tender, was jerked off the rails, and the off-side wheels landed on the sleeper between the rails, more than 1ft. from the outer rail of the curve. I think that the tender of the second engine and all the vehicles behind it must have left the rails immediately afterwards, as nine sleepers next to the first four, that were marked lightly with a wheel flange, are reported to have been cut through and broken to pieces in a very remarkable manner. The coaches, after leaving the rails, crossed gradually towards the near side rail, which was broken at the joint, and allowed six of the carriages to run down the bank and fall over in the ditch. From the position of the coaches in the field, I think that the couplings between these carriages must have held on until the coaches fell over on their sides in the field, and that the coupling between No. 429 and No. 167 van was one of the last to break.

I have no doubt that it was the force and the weight of the engines that first displaced the permanent way, and I think that the drivers, on feeling the oscillation—which probably commenced to be very great when their engines reached the short piece of straight and level road between the reverse curves—applied their steam brakes, and jerked one, if not more, of the coaches off the rails, and that on perceiving what had happened, they re-applied steam, so as to get away from the train. These men also stated that they were 230 yards beyond the first disturbance when they saw the van off the rails; that then they applied their steam brakes partially, so as to pull up their engines quietly, and that they stopped their engines in a distance of about 220 yards. They admitted that they were running at a speed of about thirty-five miles an hour at the time they saw the van off the rails, and that instead of their speed being checked by the van being off the rails, the driver and fireman of the second engine stated that the reason of their looking round was that they noticed that their engines were gaining speed.

I thought these statements so improbable, that I tried both the engines on the Chertsey branch, which is level for about three miles. I found the pilot engine, although a goods engine, to be a steady-running and speedy engine. When it was running at a speed of about 35 miles an hour I stopped it, by putting the steam brakes hard on, in about 380 yards; at a speed of about 38 miles an hour, I stopped it in about 400 yards; and when at a speed of about 39 to 40 miles an hour, in about 450 yards. I found the train engine an unsteady engine, and I could not get up a greater speed than about 28 to 30 miles an hour in the mile of level that was available for the trials, although the coupled wheels of this engine were much larger than the goods engine wheels. This engine is deficient in steam power. The cylinders are 18in. diameter, and have a 22in. stroke, and the boiler was pressed to 120 lb. of steam. It appeared to be an old engine, and quite unfit to run a train at the speed at which the 4.33 p.m. train from Salisbury was timed to run, as it could only keep time by running at a dangerous speed down the inclines.

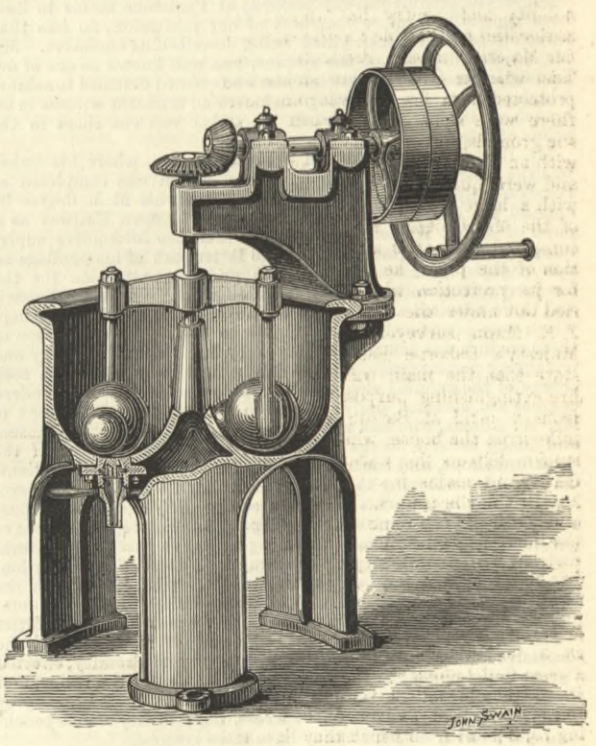
The London and South-Western Railway Company has had three cases of passenger trains leaving the rails since September last. The first, which occurred near Portsmouth, was caused by the great oscillation of the last coach of the train. The oscillation made the springs of the coach turn over, and then it left the rails. This coach was of bad construction. The second, which occurred at Brockhurst, in January, was caused, like the present disaster, by a train made up of inferior rolling stock, being run at express speed, along an old and very light permanent way.

The numerous complaints which have been made of the violent shaking which passengers experience when travelling on parts of the London and South-Western Railway leave no room to doubt that a great deal of reform in the management and improvement in the working of this railway is required. I believe the complaints are caused in a great measure by bad driving, using inferior stock, and by the coaches in the trains not being properly coupled up. I would strongly urge the company to make a thorough examination of their system and stock, to classify their drivers, to classify their stock, to classify their several lines and parts of their system, and to classify their trains. It cannot be expected that the whole of a company's stock and railway shall be of the best description, but the public has a right to expect that old and inferior stock shall not be run over old, weak, and inferior parts of the railway at such a speed as to make it unpleasant and dangerous to all that use it. If the 4.33 p.m. train from Salisbury had been fitted with a good continuous brake, the train engine-driver might have checked the speed and oscillation, by means of the continuous brake, without endangering the safety of his train; but in the case of the Portsmouth accident, when the train was fitted with the continuous automatic air brake, the engine-driver made no effort to get it to work properly before he left Waterloo. He started from Waterloo and ran to Portsmouth without the brake being available if it had been wanted.

The Salisbury and Wimborne Railway is a single line. The passing places of up and down trains are changed when required by telegraph. This is a dangerous mode of working, and it was the reason why the second engine was attached to the 4.33 p.m. train, instead of the engine being sent forward as a light engine. If the line had been worked by train staff, as it should be, there would have been no difficulty in sending forward the pilot engine, instead of attaching it to the passenger train.

MACHINE FOR GRINDING INDIGO AND ULTRAMARINE.

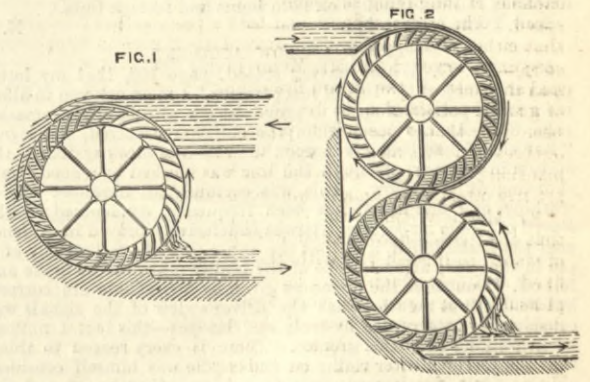
THE accompanying engraving illustrates a machine for grinding indigo and ultramarine as made by Messrs. Pierron and Dehaitre, of Paris. It requires no explanation. Two paddles on a crosshead on a vertical shaft push ahead, each of them, two cast iron spheres of different diameters. These spheres, on rolling over the indigo or ultramarine slightly moistened with water, reduce all the granular portions to a very fine paste. The spheres having different diameters, the smaller ones have not the same rolling circumference as the larger ones, and the process of grinding is said to be accelerated. For extracting the ground material a screw cap in the form of a valve is used. It is only necessary to unscrew by a few turns the threaded rod which carries the conical cap, to cause the latter to leave its seat and give sufficient passage for the flow of the ground material. The crosshead revolves at from 50 to 60 revolutions per minute, and is said to be capable of grinding 33 lb. of indigo in ten



hours. We should have thought that the machine would have been simplified and improved by placing the pan on a slightly inclined revolving axle, and if necessary inserting one fixed finger or paddle at the upper part to keep one of the pairs of the balls there. It will be observed, moreover, that this machine is like that of Evans, illustrated in THE ENGINEER, of 1st December, 1882.

DUPONCHEL'S ARRANGEMENT OF OVERSHOT WATER-WHEELS.

OVERSHOT water-wheels are of two distinct classes. In one the water is admitted above the crown, and falls upon the front of the wheel, which descends while the back rises. The bottom of the wheel therefore moves in a direction contrary to that of the escaping water, which causes a retardation. Moreover, it is impossible to prolong the circular race, which closes in the front



of the wheel, for preventing the water from flowing over the buckets. If, indeed, the race were prolonged to the centre line of the wheel, the water escaping would have to change its direction suddenly, so as to flow away. In the second type the water enters the buckets at the back of the wheel almost vertically, so that its lower part moves in the same direction as the escaping water. In this way the above-named defect is avoided, but part of the useful effect due to the fall is lost, owing to the water entering below the crown of the wheel. M. Duponchel, engineer-in-chief of French Ponts et Chaussées, has aimed at

reconciling the advantages of both systems, while at the same time avoiding their defects. He arranges his wheel, as shown by Fig. 1, so that the water enters it at the crown, fills the buckets on the front side, and escapes at the bottom without any change of direction. When the fall is considerable, he adopts two wheels of the same diameter, placed one above the other, but revolving in different directions, as shown by Fig. 2. The water is admitted at the crown of the upper wheel, fills the bucket on the front side, and flows from them at the bottom into the buckets on the back of the lower wheel, which it leaves at the bottom, also without any change of direction. M. Valez, conductor of Ponts et Chaussées, was associated with M. Duponchel in his invention.

LETTERS TO THE EDITOR.

(*Continued from page* 119.)

THE LATE MR. MANBY.

Sir,—The concluding paragraph of your memoir of Mr. Charles Manby in the number of The Engineer for August 8th is likely to convey a false impression, which, as his stepson and executor, I will ask you to allow me to correct.

Mr. Manby's funeral was conducted in exact accordance with his wishes on the subject; he objected very strongly to a large number of followers or any kind of display on such occasions, therefore, though sorry to disappoint his many acquaintances, we felt bound to carry out his wishes, so far as lay in our power. The facts of the case were fully explained by me to Mr. Forrest, the secretary of the Inst. C.E., in order, if possible to prevent any of Mr. Manby's acquaintances feeling hurt at the non-issue of invitations to the funeral; and I am somewhat surprised that Mr. Forrest should not have thought fit to inform the engineering journals of the reason for the complete privacy of the ceremony.

The Greys, Eastbourne, August 12th. A. R. Hood.

[Though reluctantly, we are forced to the conclusion both from Mr. Hood's letter and from the correspondence with Mr. Forrest, that there is no reason for our making any alteration in the paragraph referred to. Mr. Manby had a large number of friends, not mere acquaintances, of many years' standing, and it is generally thought that while display or the ostentation of a large invited following would have been entirely opposed to his wishes, these would have been best respected if some of his many warm friends and supporters had been permitted without invitation to have paid the last tribute of esteem.—Ed. E.]

THE LATE MR. MASSEY BROMLEY.

Sir,—The terrible railway accident at Penistone seems to have been especially fatal to members of our profession, no less than three out of the six men killed being described as engineers. Mr. Massey Bromley, one of the victims, was well known as one of our leading locomotive superintendents, and seemed destined to achieve a high position as a consulting engineer and scientific witness in his branch of the profession, when his career was cut short in the prime of life.

Mr. Bromley was a native of Wolverhampton, where his father was the vicar of a large parish. His education was completed at Brasenose College, Oxford, and after taking his M.A. degree he entered the Stratford shops of the Great Eastern Railway as a pupil of Mr. S. W. Johnson, who was then the locomotive superintendent of that line. During the latter part of his pupilage he was engaged in inspecting engines under construction for the company at the works of the Avonside Engine Company at Bristol, and there acquired a knowledge of the organisation of a workshop, which was afterwards very valuable to him. The completion of these engines was much accelerated by Mr. Bromley's energy and unflagging perseverance, and on his return to Stratford he took charge of the running shed at Stratford, where over one hundred engines are steamed daily. He then became general assistant to Mr. W. Adams, who had meanwhile succeeded Mr. S. W. Johnson, and finally became works' manager, having entire charge of the Stratford shops, and control over the repairs in the out stations. On Mr. Adams leaving the line for the London and South-Western, Mr. Bromley became his successor at the early age of thirty-one, and continued the work of improving the rolling stock and shops of the line. The Great Eastern, passing through a purely agricultural district, with a stationary, and in some cases decreasing population, has never been a prosperous line, being over-burdened with the capital spent in compensating landowners before the days of compulsory purchase at a fair valuation. The great business abilities of Mr. Swarbrick, for many years the general manager, and the successive efforts of Messrs. Johnson, Adams, and Bromley, effected a great improvement in the regularity and speed of the trains, and their rigid and systematic economies raised the line from bankruptcy to a state just short of financial success, the ordinary shares touching 75, a point from which they have since receded.

Owing to causes which have never been fully explained, but which in the opinion of those who knew him best reflected no discredit upon Mr. Bromley, he resigned the post of locomotive superintendent of the line in August, 1881, but received a handsome retaining fee to act as consulting engineer for the company. Mr. Bromley shortly afterwards went into partnership with Mr. John C. Wilson, M.I.C.E., and soon acquired an excellent practice as a scientific witness in railway cases, and designed a considerable amount of rolling stock and machinery for foreign and colonial railways. Mr. Bromley was a man who was endowed with a combination of many great and valuable qualities which alike endeared, him to those around him, and enabled him to achieve much as an administrator and an engineer; and it is reasonable to suppose that had his life been prolonged he would have risen to the very highest rank of his profession.

He had a marvellous memory, and never forgot a fact, a face, or a name, and knew the Christian name and chief characteristics of nearly every workman and engine driver on his line. He was a perfect mine of general information, especially as regards the details of railway practice on both home and foreign lines.

New York, August 2nd. N.

THE WILMSLOW ACCIDENT.

Sir,—Mr. G. Whale having stated, page 105, that my letter upon this subject is "full of inaccuracies," I must ask you to allow me a small portion of space to prove the correctness of my remarks; page 85. At the time when the collision occurred, the signal "line clear" had been given upon the absolute block system to the station in the rear, although the line was blocked by a goods train shunting at Wilmslow. This was certainly an improper way of working, and one which has been frequently condemned by the Board of Trade inspectors. It was conclusively proved in evidence that the brake failed, and that the cause was the falling out of a pin in the gear; also that one of the tender brake blocks broke and fell off. Doubtless the distances given by Mr. Whale are correct, but he does not mention that the driver's view of the signals was considerably interrupted by trees and bridges—this fact I noticed when walking over the ground. There is every reason to think that the foreman fitter riding on the engine was himself considerably at fault, for it was given in evidence that he opened the regulator before the driver had time to reverse the engine, thus practically putting steam on in forward gear. With regard to the fact that the verdict of manslaughter was returned upon the evidence that the driver could have stopped in 350 yards, I have only to say that jurymen themselves told me that they arrived at the conclusion they did on that statement, and no persons are more sorry than the jury that they returned the verdict they did. The fact that the case was dismissed by the magistrates with the remark that "there was no case at all," and that the grand jury ignored the bill, is surely enough proof that the driver was not guilty. It is to be regretted that no Board of Trade inquiry has been held, as important matters would then be properly brought forward. When one of these trial engines came into collision at Prestbury, a practical experiment—which I witnessed—was made to prove the distance in which the engine could have been stopped.

Mr. Whale enters largely into personalities, but as these are not arguments, and therefore of no importance, I do not propose to take up your space or my time by discussing my "knowledge of railway working, &c.;" my name is too well known to your readers and on railways to render it necessary for me to do so. In conclusion, I must refer to the word "misrepresentations," and most distinctly deny ever having descended to such means of discussion; on the other hand, it has always been my invariable practice never to make or write any statement to which I am not perfectly prepared to swear in a court of law. Clement E. Stretton.

40, Saxe-Coburg-street, Leicester,
August 9th.

Sir,—We engine-drivers have read with some degree of regret and amusement the letter by Mr. G. Whale in your issue of last week. We have read the letter by Mr. Stretton, and we know the facts to be truly given. It is stated that Mr. Stretton "knows nothing of railway working," but we have a strong suspicion that the truth is he knows too much of railways, and does not fear to state his opinions, to point out defects, and to take the part of the poor unfortunate servants when they get unjustly committed for manslaughter. The name of Stretton is known from end to end of our railways as the only gentleman who will give a driver a helping hand out of such difficulty, and no one knows this better than the numerous men he has during past years gratuitously defended and assisted, and by his legal and railway knowledge prevented being sent to prison on an unjust charge of manslaughter.

A London and North-Western Driver.

Loco. Department, Crewe, August 11th.

LOCOMOTIVE CRANK AXLES.

Sir,—Allow me through your valuable paper to make a few remarks on the above subject. I have had over thirty years' experience in the manufacture and manipulation of steel for light and heavy forgings, and during the last several years with one of the largest locomotive crank axle makers in Lancashire, who made 300 to 400 crank axles annually. This company has records from the principal railway companies, showing its axles to have run from 200,000 to over 400,000 miles. I maintain that these results have been obtained by good material, but more especially by proper manipulation under suitably sized hammers and from suitably sized ingots. Nothing can be said against the material of which the axle was composed which caused the late sad accident on the Manchester, Sheffield, and Lincolnshire Railway at Penistone.

I am not at present interested in any steel-making firm whatever. My object in writing this letter is to impress upon railway companys' engineers the importance of seeing that makers of their crank axles have large enough hammers to deal with an ingot of sufficient size and weight. An ingot for an ordinary sized locomotive crank axle should not be less than 24in. square, nor weigh less than 70 cwt., and not manipulated in the cogging process under a hammer less than 15 tons. Smaller hammers will do for finishing the forgings, and in this process the fibrous structure of the crank arms may be destroyed if care is not taken when heating to cover up those portions of the forging that are not intended to be manipulated. Repeated heatings on any portion of a forging without manipulation will produce a crystal fracture, and will be seen in the tensile test piece cut out of the crank arms after the forging is finished, and will break with a very low percentage of elongation and reduction of area at point of fracture. All mild steel ingots made suitable for axles are hollow about one-third from the top end, and this occurs even if the ingots are compressed when in a fluid state, therefore ingots should be made heavy enough to allow the axle to be made from less than two-thirds of the bottom end. Ingots, when cast, should be kept on their ends after taking them from the casting pit until the fluid steel in the centre is fully set: if laid on their sides before they are set it will be found that the hollow part has formed nearer to the bottom end, and consequently more liable to get into the crank forging. It is always better to charge ingots into the hammer furnace before they are cold, but care should be taken not to do this too soon after taking them from the mould, or the fluid steel may not have set, and you have the same evil as above. When they are charged cold they sometimes clink, and when this takes place there is a rupture of the steel somewhere, and these ruptures may not be external and seen in forging or even machining after the forging is finished. These clinks may be heard by the furnacemen, and therefore such ingots should not be used for crank axles. Steel high in silicon and manganese is most liable to clink when charged cold. An internal rupture caused by this clinking when charging the ingot cold may be in any part of a crank, and, as stated above, not seen in machining, but it is the starting point of a growing flaw. G. W. Dyson.

Bolton, August 10th.

Sir,—I did not claim, as you seem to think by your footnote to my letter, the hooping of cranks as an original idea. I am well aware that some locomotive, and also some marine, engineers have adopted the plan, with this difference—that I have not yet seen a *weldless* hoop, as suggested in my last, used, but invariably a bar bent, and its two ends welded together to form the hoop, which, for obvious reasons, is not so good. J. W. de V. Galwey.

Warrington, Lancs., August 10th.

TESTING IRON BY MAGNETISM.

Sir,—In answer to your correspondents, I have tried many experiments on bars made up of filings and wires, and found that want of homogeneity showed itself by change of magnetic power. I used a magnetic needle ¼in. long suspended on a point which was drawn along near the bar, the deviations and distances being noted—these should be nearly regular if the bar be homogeneous—the bar was then turned on its axis and a similar set of observations taken; from a series the defect could be inferred. Before taking observations a bar electro-magnet was placed at each end, and while the current was flowing the end of the bar was struck with a mallet, the current was then broken and the electro-magnets taken away. I tried a number of experiments on a bar of iron 1¼in. square, 12ft. long, and found points of magnetic change after submitting it to stress in different directions. Having to leave my laboratory I could not continue the investigation; but if further experiments were pursued, I feel certain that flaws could be detected, and also whether the metal had been overstrained. I showed some of my experiments at the British Association, Bristol, 1875.

Charging batteries is rather tedious work; but now that the dynamo gives an easy mode of obtaining a powerful electric current, I hope these experiments may be continued, and I have every reason to think some useful information will be obtained.

I trust my calling attention to this matter may result in practical usefulness. Philip Braham, F.C.S.

Bath, August 11th.

The New York City Board of Health has adopted an ordinance forbidding the use of any tap, faucet, tank, fountain, or vessel, or any pipe or conduit in connection therewith, for storing beverages for drinking, which shall be composed of or made with brass, lead, copper, or other metal or metallic substance that is or will be affected by liquids, so that dangerous, unwholesome, or deleterious compounds are formed therein or thereby, or such as beer, soda-water, syrups, or other liquid, or any other beverage, drink, or flavouring material drawn therefrom, shall be unwholesome, dangerous, or detrimental to health.

ON REPAIRING THE CABLES OF THE ALLEGHENY SUSPENSION BRIDGE AT PITTSBURGH, PA., U.S.*

By Mr. Francis Collingwood, M. Inst. C.E.

The author was called upon, in August 1883, to examine the suspension bridge across the Allegheny river at Pittsburgh, and to report upon its condition. The bridge had been in constant use since 1861, having been built by the late Mr. John A. Roebling, well known as a designer of this type of bridge. It consists of two full spans of 343ft. 2in. length each, and two half spans of 179ft. 1in. each. The floor is about 41ft. wide, and is supported on four cables made of iron wire of an average diameter of 0·145in. The inner cables are 22ft. between their centres at the lowest point, and spreading to 26ft. at the points of suspension. Each cable contains 2100 wires laid up in seven strands, and measuring 7½in. in diameter. The outer cables are 42ft. between their centres at the lowest points, reduced to 38ft. at the point of suspension. Each cable contains 700 wires laid up in two strands, and is 4½in. in diameter. There are heavy iron parapets at the outer sides of the sidewalks, and a system of long stays to each cable, to stiffen the bridge against vertical oscillations. The serving or so-called wrapping-wire on the cables measures 0·098in. in diameter, and is included, of course, twice in the diameter given for the cables. The strands pass at the anchorages round cast iron shoes, and the shoes are attached by pins to wrought iron anchor bars. At each end of the small cables there are three, and at each end of the large cables nine, such bars. Those for the large cables are in two sets, so arranged that a rectangle surrounding the strands at the point of attachment is 22in. square. These bars are the upper set of a series of similar ones, the lowest of which take hold of the anchor-plate, and all the bars and the strands—to the clamp to be mentioned—were buried in the masonry of the anchorage. From the shoes the strands converge for about 12ft., at which point they are brought to a round form and held in close contact by a heavy iron clamp. From thence they are wrapped throughout, except where they pass over the saddles at the towers. Between the shoes and the clamp the wires in each strand are brought compactly together by a seizing of several turns of annealed wire at intervals of about every 7in. As originally finished, this unwrapped part of the cable was enclosed in heavy cotton duck, and all interior spaces were filled in solid with hot coal tar, which had been boiled and treated with quicklime to neutralise any acid it might contain. As an additional precaution, the portion from the clamp 3ft. back into the masonry was surrounded by ¼in. boiler plate tightly clamped on, and coal tar pitch was poured around the outer end. The whole cable for 12ft. back, including the shoes, was then enclosed in brickwork and cement; 6in. flags were laid in cement over the brickwork, and finally a second set of flags above these, to form the sidewalk. Over the side cables, the foundations to the tool houses took the place of sidewalks. Examinations had been repeatedly made at the points where the cables emerged from the masonry to see that the coverings were intact, but no more extended examination had been deemed necessary. The author felt, however, that the responsibility was too grave to allow him to assume that all was sound simply because the exterior appeared so. The sidewalk and flagging were therefore removed from one end of a large cable, and on cutting through the canvas it was found that the tar had partially disappeared, and that the cavity was nearly full of a dirty, greyish liquid. There was also extensive rusting of the wires, so that the seizing wires, 0·06in. in diameter, were in many places rusted through, and the cable wires deeply pitted. A second cable end was opened with similar results. A general survey of the bridge was then made, revealing fine cracks in the paint on the cables which admitted moisture, gave defects in the masonry, particularly of one of the piers, and a number of other minor flaws. A full statement of the facts was thereupon made to the directors, with the recommendation that every cable should be examined throughout and repairs made immediately; also that the cables and other ironwork should be scraped and repainted, all defective stones in the piers replaced by sound ones, the masonry re-pointed, and that the wrought iron protecting plates to the pier nosings should be repaired, &c. Authority was given to the author to proceed with the work at once. As parts of it were entirely novel, it required close personal attention throughout. The first step was to determine how far the damage to the cables extended. One of the openings already made was therefore enlarged, and the boiler plate and wrapping removed, so as to expose the strands back to and around the shoes. It was found that the rust extended outside of the anchorage, and under the wrapping. It was then decided to remove every seizing, to cut a slit about 45ft. in the bridge floor to where the cable emerged above it, and to remove the clamp and also the wrapping so far as might be necessary to discover the full extent of the damage. Accordingly, about 10ft. length of cable was unwrapped, leaving the wires exposed and entirely free for about 22ft. of their length. On examination the serious damage to the wires was found to extend about 3ft. from the anchorage outward. Beyond this there was a little dry rust, but no pitting; and still farther from the anchorage the paint on the interior wires was yet gummy. The rust seemed to be of two kinds. First, a red oxide, where the wire appeared to have been attacked as if by acid, the so-called fibre being exposed. In some such cases the rust had eaten through the exterior in a narrow slit, and had then attacked the interior, leaving a shell only. The second form of rusting was by the formation of a hard blackish substance containing much sulphur, which, when scaled off, left a deep pit, as if gouged out by a chisel. In one cable end eight wires had been eaten entirely through, and one wire or more in each of the others. Referring to the composition of the rust and the liquid found among the strands, the following letter to the author is pertinent. The writer, Professor Otto Wuth, is a practical chemist residing in Pittsburgh, and has been engaged in the manufacture of the various products resulting from the distillation of coal tar:—

"Pittsburgh, August 18th, 1883.

"I have carefully examined the specimens of scales you took from the wires of the cables of the suspension bridge, and found them to be a combination of the hydrated peroxide of iron and sulphate of iron. The liquid consisted of a weak solution of carbonate and sulphate of ammonia, coloured by tarry matter, and is almost identical with tar water from the gasworks. The cables, as you stated, were first coated with boiled linseed oil and afterwards with coal tar. The tar had evidently not been heated long enough and high enough to drive off all the water and the salts of ammonia contained in all coal tar at the rate of 5 to 7 per cent. The reaction of coal tar is always alkaline—very alkaline—never acid. The reaction of the acids contained, such as carbolic and cresylic, is also alkaline; they do not act like the mineral acids on iron. By heating coal tar with caustic lime you only convert the carbonate of ammonia into caustic ammonia. Now the action of the coal tar upon the wires has undoubtedly been this. The oils contained in the tar first dissolved the coat of linseed oil; then the sulphuret of ammonia, which is contained in tar in considerable quantity, acted upon the surface of the iron, converting it into the sulphuret of iron which again was converted into the sulphate by the oxygen of the air, which could not have been completely excluded. This alternate action of the sulphuret of ammonia and air was continued until the sulphuret was entirely exhausted. The oxidation was further carried on by the atmospheric air in the presence of water and carbonate of ammonia."

How the water came to be where found it is not easy to say. The upper surface of the strands was about 18in. below the surface of the sidewalk, and exposed to considerable alternations of heat and cold. A cavity was evidently formed by the tar gradually oozing into the surrounding brickwork when exposed to the heat of hot summer days. Air would then slowly percolate to and fro as the masonry changed in temperature, and moisture would

* Other Selected Papers, "Transactions" of the Institution of Civil Engineers.

probably be condensed, and the water slowly collected. It is possible that part of the sulphur and ammonia accumulated in this way, as they must be constantly present more or less in the atmosphere of such a smoky city as Pittsburgh. It was evident that the only course to pursue was to cleanse the wires thoroughly. This was at first attempted by the use of solvents such as benzole, kerosene, &c.; but it was impossible to cleanse the interior strands in this way even by drenching them. Scraping each individual wire was then reluctantly resorted to. After trying various scrapers, none of which worked satisfactorily, one was adopted which proved cheap and effective. A $\frac{3}{16}$in. steel rod had one end flattened and turned up for about $\frac{1}{2}$in., so as to make with the rod an angle of about 80 deg. A semicircular notch, of about the same diameter as the wire, was then filed in the end, and the edge made sharp, hardened, and tempered. With these, four men could clean about 175 wires in 10 hours. To get at the interior strands, wedges were used to force them apart. Whenever a damaged wire was found it was marked by a bit of wire twisted on. All such wires were examined, and if the loss of strength was 10 per cent. or more, it was repaired, otherwise it was passed. It was soon found that the damage was almost entirely confined to the other two layers of wires in each strand. The seizings around the strands held the wires so closely in contact that the destructive agent had not penetrated farther. While this preliminary work was going on, experiments were made to determine the best method of repairing the damaged wires. The only previous work of this kind, so far as known, was that done at Niagara Falls;* where, in making the final splice, the two parts of a wire were keep under strain by a bar having a lever pivotted across each end. The shorter arms of these levers were provided with clamps and thumb-screws for taking hold of the ends of the wire to be joined, and gave a lever arm of 2in. The other arms were 10in. long. The short lever ends having been clamped to the extremities of the cable wire, one of the long arms was fastened by a wire to some fixed object; to the second long arm a spring balance was attached, and to this a pair of small pulleys and tackle, leading finally to some other fixed object. By this means a definite pull on the balance could be transmitted to the two branches of the cable wire, since the separation of the long arms would draw the short ones towards each other. The difficulties with this apparatus were, first, that it was not self-contained; secondly, the range of motion being small, it required exact fixing on the wires to ensure the ends being in line when the strain was on; thirdly, the room was insufficient for wrapping the splice. The author devised an apparatus as follows:—A stiff square bar 2ft. 6in. long had its sides finished smooth, one end was flattened, and to this end a stiff crosshead about 7in. long was firmly rivetted. One end of the crosshead was provided with a clamp and thumb-screw for holding the wire to be spliced. The other end of the cross bar had a notch for receiving the ring of a heavy spring balance. A second cross bar about 11in. long was fitted with a long socket near its centre, so as to slide freely on the long bar. One end of the sliding bar had also a clamp and thumb screw for holding the opposite end of the wire to be spliced. Through the remaining end of the sliding bar was a hole parallel to the main bar of the machine, through which an eye bolt passed freely. The eye bolt had a long thread cut upon it, and carried a hand wheel with a corresponding internal thread. The hook of the balance passed through the eye of the bolt. This machine gave plenty of movement for extending the balance, and taking up the slack of the wire, and was very convenient in all contracted places. According to Mr. Roebling's original notes, an abstract only of which was available, the maximum working strain per wire is 267 lb., of which 109 lb. or 41 per cent., is live load, and 158 lb. or 59 per cent., is dead load. A piece of wire said to be from the original bridge wire was tested, with the undermentioned results:—The stretch in this and the following tests was taken on 1ft. of length by a finely divided vernier gauge, having a multiplying lever, and a second vernier for the finer readings. Diameter of specimen, 0·144in.; area, 0·16286 square inch. The readings were uncertain up to 200 lb. strain, owing to inaccuracy in the adjustment of the gauge.

Strain. lb.	Gauge reading. ft.	Difference. ft.
200	1·00017	
		0·00023
300	1·00040	
		0·00024
400	1·00064	
		0·00023
500	1·00087	
		0·00022
600	1·00109	
		0·00022
700	1·00131	
		0·00020
800	1·00151	
		0·00033
900	1·00184	

At 1260 lb. the wire broke with a measured set of 0·013ft. Diameter at point of rupture, 0·110in.; strength per square inch of full section, 77,365 lb. A new splice in a wire when tested gave, under a strain of 300 lb., an addition of 0·018in. in length by slip and stretch. Now in splicing in a new piece of wire, the final splice must evidently be made under an excess of strain sufficient to compensate for three things—first, for the probable slip in the splice in taking up a working strain; secondly, for the stretch that will occur in the part—about 2ft. long—contained in the machine while splicing, when it comes under strain; and thirdly, for the extra strain induced by pulling the wire out from a straight line while splicing. To determine this excess of strain the following calculations were made:—

	In.
The slip at the splice is, say	0·0180
Taking 200 lb. as the average strain in a wire with the bridge in use, and 0·00023ft. as the stretch per 100 lb., the 2ft. length of wire in the machine will stretch 0·00023ft. $\times \frac{200}{100}$	0·0110
$\times 2\text{ft.} \times 12 =$	
Suppose the wire in splicing to be drawn 4in. from a straight line at the centre of 20ft. in length, the additional length required is=	0·1332
Total excess of length requisite in making the splice=	0·1622

On the supposition that the wrapping around the cables is tight enough to oblige the first 10ft. length under the wrapping to take up the extra strain, and inasmuch as the wires pass around the shoes and have therefore a double length, the strain would act on about $(12^1+10^1+10^1\times 2)$; or say 60ft. length of wire. According to the previous test, to stretch 60ft. of wire 0·1622in. a strain would be required equal to

$$\frac{0\cdot1622\text{in.}}{12} \div \frac{0\cdot00023\text{ft.}\times 60\text{ft.}}{100} = 98\text{ lb.}$$

This would give the strain on the balance as 200+98, or say 300 lb. A balance with 400 lb. capacity was therefore provided, but on trial it was found that a pull of about 500 lb. was necessary to ensure a full strain in the wire after completion of the splice. The reasons for this seemed to be, first, that the stretch did not probably reach so far as 10ft. under the wrapping; secondly, the friction in passing around the shoe had not been taken into account; thirdly, the wires were frequently partially bound by other wires, and the final splice was nearer one end of the free wire than 10ft. Another element of uncertainty was the constantly varying load, as the traffic on the bridge is very heavy and subject to rapid and extreme fluctuations. Still another practical difficulty was the fact that from loosening the strands and removing the clamps and wrappings, the angle made by the unwrapped strand with the round cable was removed 10ft. farther from the shoes and the several cable wires were no longer equally strained. For these various reasons it became necessary to assume limits to strain, within which differences would be allowed. As the limit of elasticity of the wire was from 800 lb to 1000 lb., and the extreme working strain 267 lb., it was evident that if the minimum strain per wire was sufficient, the maximum might be largely increased without danger of rupture or inharmonious working. Futhermore, any excess in pull in the sound new wires would tend to relieve the slightly damaged wires which were not to be repaired. This reasoning of course would not apply if carried too far, since an excess of strain introduced into a large number of wires for a considerable length would have changed the curve assumed by the cable. The minimum fixed upon was 200 lb. per wire, and was ensured in the following manner. Each wire as spliced was marked by a tag, and once a day all the wires were tested, by applying a spring balance at the centre of their free length, and pulling them out 2in. from the straight line. Suppose the balance to then mark 8 lb., by the parallelogram of forces the proportion $\frac{4}{12}$in. : 10ft. = 8 lb. : 240 lb. = strain of wire. This simple test saved all necessity for immediate inspection of each splice. Two men could repair from eight to ten wires daily, making two splices in each. They soon found that they were able to dispense with the weighing aparatus, and to judge the tension closely enough by feeling. A simpler tool was then constructed for holding the wire while splicing. It was made of two bars or legs hinged together, and each bent so as to assume a form much like a pair of pin dividers when they are opened wide, and the pin and point are in position for use. A tightening rod, with a head at one end and a thumb screw on the other, passed through the legs at the knuckles. The lower end of each leg was grooved across on one side; and a wedge key fitted for clamping an end of the wire to be spliced. Most of the splicing was done with this tool; but the one with the balance was best where the space was contracted. The total number of wires spliced was four-hundred and eighty-four, of which one-hundred and seventy-five were in one cable end and one-hundred and seven in another. Care was taken to distribute the splices lengthwise, so as not to interfere with the smooth wrapping of the cable. The splices were made by filing the end of the wire to a flat sloping face of 3in. length, and so as to reduce the wire at the extremity to about one-third its diameter. The wire was then laid face downwards on an iron anvil, and the convex side nicked for 3½in. with a tool, having spaces of 0·033in. to correspond with the diameter of the splicing wire. After preparing the two ends, they were placed in the machine, the proper strain was applied, and the flat surfaces were brought in contact and tightly clamped by a hand vice on each side of the centre of the splice. The splicing wire was next tightly wrapped by hand; beginning at the middle of both splice and wrapping wire, and wrapping up to one of the hand vices, then removing this vice to a second and third hold, and each time wrapping up to it. The final finish at this end was given by wrapping $\frac{3}{16}$in. beyond the filed portion of the wire, and fastening the splicing wire by passing it twice under its own coils. The opposite half splice was finished in the same manner. The integrity of the splice depends upon the care taken in adjusting the parts accurately to each other, and keeping a constant strain on the splicing wire. Comparative tests were made of a piece of wire from one of the cables, and of a new splice in the same, and the results are given below. Diameter of wire = 0·144in., area = 0·16286 square inch. The whole wire behaved as follows:—

Strain. lb.	Gauge reading. ft.	Difference. ft.
200	1·000050	
		0·000240
300	1·000290	
		0·000245
400	1·000535	
		0·000250
500	1·000785	
		0·000210
600	1·000995	
		0·000270
700	1·001265	
		0·000275
800	1·001540	

At 1450 lb. the wire broke with a set of 0·0208ft. on 1ft. The reduction of area at the point of rupture was 51 per cent. The strength per square inch was 89,015 lb. The splice from the same piece of wire gave results as follows:—

Strain. lb.	Gauge reading. ft.	Difference. ft.
100	1·000390	
		0·000225
200	1·000615	
		0·000665
300	1·001280	
		0·000505
400	1·001785	
		0·000550
500	1·002335	
		0·000405
600	1·002740	
		0·000450
700	1·003190	
		0·000285
800	1·003475	
		0·000180
900	1·003655	

At 1350 lb. the spliced wire broke with a set of 0·0243ft. on 1ft. The rupture occurred in one wire at 2½in. from the end, or 1in. from the centre of the splice, and with a large local reduction in area. In making the test the coils of wrapping wire were left slightly loose at the ends to represent a probable case in actual work. In comparison with the uncut wire, the splice shows a strength of 93 per cent. Since the splice at one end of each piece of new wire introduced has been subjected to a strain far above the working strain, and the final splice has resisted a pull of at least 200 lb., it is evident that the greatest possible additional slip would be that arising from the slip at the final splice, due to the difference between a strain of 200 lb. and a maximum strain of 267 lb. As this amount, which is very small, must be distributed over about 60ft. length of wire, it may be neglected. A piece of new Bessemer steel wire was tested, with the following results. Diameter of wire = 0·147in., area = 0·01697 square inch:—

Strain. lb.	Gauge reading. ft.	Difference. ft.
300	1·000725	
		0·000200
400	1·000925	
		0·000230
500	1·001155	
		0·000345
600	1·001500	
		0·000125
700	1·001625	
		0·000230
800	1·001855	
		0·000280
900	1·002135	
		0·000270
1000	1·002405	
		0·000335
1100	1·002740	
		0·000405
1200	1·003145	

At 1550 lb. the Bessemer steel wire broke with a set of 0·0243ft. on 1ft. The reduction of area at the point of rupture was 47½ per cent. The strength per square inch was 90,442 lb. The tensile strength of similar sized iron wire is given by the Trenton Iron Company at 91,278 lb. per square inch. Considering that the old wire was more or less damaged by rust, its uniformity of stretch, large reduction, and close approximation in strength, shows it to be entirely unchanged by use. All the wires in a cable having been repaired, the first step towards closing it up was to jar it thoroughly with mallets, and to get out all loose rust and dirt, after which it was thoroughly saturated with raw linseed oil. To reach the interior wires with the oil, a chisel bar had to be forced through in every direction until no uncoated wire could be found. Two days afterward a coating of boiled linseed oil was applied, and then the seizings were replaced on the part of the strands not to be wrapped. The most serviceable tool for compacting the wires of a strand to a round form, prior to replacing the seizings, was one devised for the occasion. It consisted of two semicircular pieces of iron hinged together at one end of each, and with the free ends bent radially outward. One of the free ends was left longer than the other, and had a hole slotted radially in it, to allow play for the passage of the screw. The other free end was tapped for the screw. The screw had a thread about 4in. long, and a stem about 1ft. long, terminating in a T for convenience in turning. A collar between the screw and stem gave a bearing against the slotted end of the clamp. The interior strands, which were hard to get at, were compacted with this clamp with facility. The work of bringing the strands together again to the round form of the cable, just within the anchorage, was troublesome but not new. The wrapping of that portion outside the anchorage was at first accomplished with the special wrapping machines used when the bridge was built. As it was impossible to employ these at all points, the ordinary serving mallet familiar to sailors was afterwards adopted, as, with care, it was found that good work could be effected. The cable was saturated with white lead and oil in advance of the wrapping. Several coats of the same composition were afterwards applied over the wrapping and strands. Wherever direct vision could not be obtained, the aid of a mirror was found necessary to ensure a perfect covering. As it would afterwards have been difficult to paint thoroughly that portion of the strands near to where they converge to a round form, it was considered best to protect them by filling for a space of 2ft. back from the clamp with paraffine. To do this a dam of putty was made across the cable, and the 2ft. length was surrounded by canvas, into which melted paraffine was poured until, when cold, the canvas would hold no more. Changes of temperature have thus far had no effect upon the paraffine as a protection. Experience having demonstrated the imperative necessity of having all parts of the cable accessible for examination, it was decided to leave tunnel openings around the strands in the anchorages. The bottom of each opening in the masonry was therefore cut so as to drain to an opening in the front wall. The sides were removed to about 6ft. by 16ft., and lined with 13in. brick walls laid in cement-mortar, the cable passing freely through the front wall, with space all around for painting. A jacket was afterwards put on each cable, to keep out moisture as far as practicable. As the head-room was insufficient for brick arches, the side walls were capped by an iron box-frame, which was covered by a series of cast iron plates grated on the upper surface, which surface was at the side-walk grade. The plates were locked together and cemented, to prevent water from dropping on the cables; and the last plate of the series was provided with lifting rings. In the alternation of mild and extreme cold weather, water of condensation was found to drip from the plates. To prevent this, a light wooden frame has been covered with well-painted canvas, and placed in the tunnel in an inclined position over the cable. Cork paint may be hereafter applied to the interior of the tunnels. The only other point of interest was the method pursued in removing the old paint from the cables preparatory to repainting. The necessity of this was made apparent by the cracks retaining moisture after every shower; as it was reasoned that fresh paint would soon crack in the same lines, and but temporarily cure the evil. Ordinary scrapers were first tried, but were ineffective on account of the gumminess of the paint. This led to the use of cutting tools, such as chisels and drawing-knives, by which to slice it off. By keeping these sharp, the work was fully trebled in quantity over that at first attainable. The average length of large cable cleansed by one man in a day was about 25ft.

* "Minutes of Proceedings" Inst. Civil Engineers, vol. lxv., p. 389.

AMERICAN NOTES.

(*From our own Correspondent.*)

New York, August 6th.

A few holders of railway securities, who exercise a great deal of control over stock markets, both here and in the interior, are endeavouring to give prices an upward tendency, for the apparent and accredited purpose of unloading large stocks of securities upon a confident market, as soon as the proper conditions can be created. The frequently recurring commercial failures are not conducive to this scheme. The rumours affecting the financial credit of several large railway properties is still further interfering with the scheme of advancing the general line of railway securities. The Northern Pacific are the most active, as well as the strongest on the list. Railway traffic from Chicago and St. Louis eastward is increasing very slowly. Every week adds to the assurances of an enormous wheat and corn crop, and these assurances are leading to an improvement in mercantile circles, and to an improving demand for a long list of productions, beginning with iron and steel, and ending with textile products.

Prices in every department of the iron trade are drooping. Large sales of rails have been made under 28 dols.; terms private; believed to have been 27.50 dols., thus showing difference between American and English rails of about 5 dols. per ton. Lower prices will, it is said, be reached, but it will result in the shutting down of the mills, which cannot make rails at such figures. The mills that will be affected are in the West—in Cleveland, Chicago, Joliet, and St. Louis. The purpose of the rail makers is two-fold—first, to crowd out as much competition as possible; and second, to induce the projectors of several large lines of road to come into market and place orders at this time, in the hope and belief that this restriction of production will enable those who continue production to sell rails at an advance over present rates. Chicago quotations are 35 dols., which can be shaded a little. Freights from Pennsylvania to Chicago are 2.50 dols. This gives the Pennsylvania mills an advantage. Merchant iron is selling at Pittsburgh at 1.50 dols. to 1.75 dols. All the structural mills are crowded with orders, and from reports just received from travelling agents, orders will soon be placed for several thousand tons of bridge iron. The plate mills are increasing their business. Nail mills contemplate a restriction. Pipe mills are taking more orders. The bloomeries are doing very little. The Lehigh and Schuylkill Valleys are making about one-third the usual amount of iron. Several thousand tons of old rails have just been bought at about 19 dols. Bessemer iron is quoted at 19 dols.; Bessemer steel slabs, 37 dols.; Welsh crop ends, 20 dols.; American old rails are held at 20 dols.; angle and plate iron, 2c.

The anthracite coal mines are producing 125,000 tons of coal daily. The Lake Superior ore mines have shipped 150,000 tons more ore this year than for the same time last year. The demand for barbed wire is slacking up, and prices at Chicago are 4½ dols.; nails, 2.35 dols.

Quotations for Scotch pig iron are:—Eglinton, 19.25 dols., to arrive; Clyde, 20 dols., to arrive; Coltness, 21.75 dols., to arrive; Glengarnock, 20.50 dols. to arrive; Gartsherrie, 21 dols., to arrive; Langloan, 21.50 dols., to arrive. There is an active demand for small lots of wire rods, and prices are as low as 46 dols. American tool steel, 9½c., with concessions on large lots; English tool, 14½c. to 15c.

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

(*From our own Correspondent.*)

The production of finished iron since my last report has been curtailed, as the result of the oppressive weather. On Monday it was considered useless at many of the works to light the fires, since the puddlers could not begin, and at some works only little was done on Tuesday also. The manufacturers do not regret the lessened output, since there is no pressure of orders. Consumers have not up to now been inconvenienced to any appreciable extent, and supplies are abundant for all their necessities.

Gas strip and nail strip was reported by a few makers this—Thursday—afternoon in Birmingham to be in a little better demand, and common bars were here and there selling slightly more freely. Upon the whole, however, the trade cannot be reported to have improved. Sheets are particularly tame, and prices of merchant and galvanising sorts were hardly ever so low. Singles may be had at £6 15s. upwards easy—indeed, from some makers they may be had at £6 10s. Galvanising doubles are £7 10s.; and lattens, £8 5s. to £8 10s., though a few houses ask as much as £9 5s.

Prices are maintained by the best—thin—sheet makers pretty well—better, indeed, than by any other branch of manufacturers. Severn singles made by E. P. and W. Baldwin are quoted £11 to merchants; Baldwin Wilden best, £12; best best, £13; treble best, £14; charcoal steels, £16 10s.; best ditto, £19 10s.; and extra best ditto, £21 10s. John Knight and Co. quote working-up singles £10; stamping singles, £14; and charcoal singles, £20.

Boiler plates are very quiet, and the mills are only partially employed. Prices range from £8 up to £9. Competition from other districts is still severe.

The marked bar houses have not much that is satisfactory to report. The call for their output is limited, and the competition of firms of less renown is increasingly severe. Export orders are finding them with the most work. Earl Dudley's bars are £8 2s. 6d. nominal for ordinary quality, £9 10s. for single best, £11 for double best, and £13 for treble best. Other list houses still quote £7 10s., but the figure is only nominal, and £7 is practically the maximum

that can be got. Between this figure and the £5 10s. at which common hurdle bars may be obtained, there is a considerable range of prices, according to the reputation of individual makers.

The pig iron trade is not more brisk than a week ago, and buyers of Derbyshire, Northampton, and Nottingham pigs are attempting to "bear" the market. Vendors, however, repeat that the relief which the new railway rates afford is so insignificant that they cannot give way in price. Northampton pigs were to-day to be had at, in some cases, as low as 39s., delivered into sidings, and Derbyshires at 40s. 6d. to 41s. and upwards. Native pigs were 55s. to 57s. 6d. for hot-blast all-mines, and 37s. 6d. to 40s. for cinder sorts.

Mail advices from Melbourne received this week state that when the mail left there was not much inquiry for galvanised iron. Quotations ranged from £19 to £21, according to brand. Bars and rods moved off quietly at £9 to £9 10s. Black sheets iron had been quitted at £11 10s. for Nos. 8 to 18; while hoops had been sold at from £9 10s. to £10. For fencing wire a slightly better demand had arisen. Quotations ranged from £11 10s. to £12 10s., according to brand and number. Tin-plates were moving off steadily. I.C. plates had been placed at up to 20s.

The demand for ironworkers' coal was slow this afternoon, and house coal was little better than a drug. Consequently the Cannock Chase coalmasters are meeting with no great success in their attempt to enforce the advanced prices of 1s. on coal and 6d. on slack declared at the beginning of the month. Best ironworks coal from the Chase appears in the new lists as 7s. 6d. per ton; second quality, 6s. 6d.; and third quality, 6s. House coal is 10s. 6d. for best deep, 10s. for yard coal and for deep one-way, 9s. for best shallow, 8s. 6d. for screened deep, 8s. for small shallow, 7s. 6d. for deep rough and London Bright, 7s. for deep and shallow nuts, and 6s. 6d. for shallow rough.

The ironworkers are protesting against the action of the ironmasters in asking the arbitrator to award a reduction. The old arguments which were repeated during the last strike are being rehearsed, and still meet with favour. At a big gathering at Walsall on Monday, Mr. Capper alleged that the ironworkers in South Staffordshire received only 3d. per ton in advance of the Northern men, after deducting 6d. per ton allowed them in lieu of the Northern extras, whereas they should receive 6d. per ton more wages, because South Staffordshire iron realised better prices! Mr. Capper, however, fearlessly told the men that they were incapable of carrying on a strike for even two weeks, and hoped that the "uncontrollable stupidity" evinced at the last drop would not be again shown. "Even if the arbitrator should award a drop, the men were in honour bound to abide by it." The resolution come to therefore merely protested against the proposal. The men in the West Bromwich district have pursued a somewhat different course. They have determined to resist any drop. It is, however, probable that the men as a whole will act upon Mr. Capper's advice.

The strike of the colliers entered its seventh week on Monday. There are as yet no signs of a speedy termination, and the legal action which the miners have just taken can have no other effect but to prolong the struggle. Four miners have summoned the Sandwell Park Colliery Company for fourteen days' wages in lieu of notice. Their advocate stated that their contention was that the employers should have given fourteen days' notice after the declaration of Mr. Rowland's award decreeing a drop. He also incidentally mentioned that some 400 cases were dependent upon the magisterial decision. As, however, the cases could not go on owing to the absence of the barristers, the proceedings have been adjourned for a fortnight.

The constructive engineers are manifesting some interest in the inquiry just now upon the market, from the East India Railway Company, for 1400 tons of steel and ironwork for the central cantilever of the Hooghly Bridge, though it is feared that our inland position will not give us much chance in the competition. Under old contracts there is at the present time a fair amount of constructive ironwork, such as piers, bridges, &c., under execution in some parts of the district for India, Australia, and South America. It is pretty satisfactory that the directors of the Patent Shaft and Axletree Company, Wednesbury, have decided this week to recommend the payment of a dividend at the rate of 5 per cent. per annum on the ordinary shares for the year ending July 30th last.

Feed-water heaters are being ordered in the Tipton district by, among other customers, several of the Sheffield steel producers. They are of very large size. Crane chains, which were quiet up to three weeks ago, are now looking up somewhat. The chain-makers are likewise fairly employed on colliery and engineers' chains. The ironfoundries, in their general mill and forge requirements' departments, have not much heavy work on hand. Machinery engineers, who enjoy a reputation for speciality work of undeniable quality, keep very fairly employed.

Manufacturers in various branches express the earnest hope that the greater request which has appeared for the products of the Scotch shipyards may prove something more than a mere spurt. Already, indeed, orders for anchors are to hand. London keeps so very quiet that an increased Glasgow trade would be satisfactory in many departments.

The galvanised sheet makers are finding the South American markets, especially Monte Video, doing a little more buying than of late.

During the past few days a party of merchants from Morocco have visited Birmingham, Wolverhampton, and certain of the other South Staffordshire towns, and after inspecting some of the manufactories, have left behind them orders which, it is hoped, may prove the forerunners of increased business.

The operative rivet makers of Black Heath, Old Hill, and the surrounding districts have accepted a reduction of from 10 to 15 per cent. on the 4s. list, in consequence of the badness of trade.

Notable remarks upon steam traction fell a few days ago from Mr. E. Pritchard at the annual meeting of the Birmingham and Aston Steam Tramways Company. As a practical man he had, he said, no hesitation in saying that there was greater convenience and greater safety in the use of steam traction than the employment of horses. Throughout the kingdom there had not been a single instance of a bogey car being upset, for its very construction rendered such an accident almost impossible. He would remind those gentlemen who saw difficulty, danger, and death in steam traction that during the past year the company had conveyed 1,518,747 people under very great difficulties practically without accident. They had run 176,528 miles at a cost per mile of 11·05d. The receipts had been 17·54d. per mile. A dividend at the rate of 10 per cent. per annum was declared.

The directors of the Warwick and Leamington Tramways Company have resolved to recommend a dividend for the past year at the rate of 4 per cent.

The South Staffordshire Waterworks Company has made a profit on the half year ended June 30th last of £12,651. This the directors propose to appropriate by declaring a dividend for the half year at the rate of 5 per cent. per annum.

At a meeting of the North Staffordshire Mining Institute, held this week, Mr. John Strick read a paper on Wavish's patent for economising fuel and preventing smoke in domestic grates; also for preventing smoke, economising fuel, and circulating water in steam boilers. The coal economiser not only prevents by a bottom plate the extravagant influence of a direct current, but, with the aid of a vertical cylinder, provides the air necessary for combustion. All the heat-giving properties of the coal are, the author contended, burnt, and the heat is driven into the room instead of up the chimney. In applying the invention to steam boilers, its importance is more marked than in domestic matters, as it deals with a greater consumption of coal. But besides the economy of coal, smoke is, he claimed, absolutely prevented from being formed, and a rapid circulation of the water is produced, thereby causing an equal expansion of boiler plates, and preventing incrustation on the interior parts of the boilers and tubes. Attention was directed to the reports of Mr. D. K. Clarke to the Council of the Smoke Abatement Exhibition, showing the value of the invention. Several members spoke approvingly of the principle of the patent.

Mr. John Gammage, assistant surveyor at Wolverhampton, has been appointed this week borough surveyor of Dudley, in succession to Mr. George Broom, who recently received an appointment at St. Helens.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—Business throughout the iron trade of this district continues in a very depressed condition, with but little change to report either in one direction or another. The actual requirements which consumers have to cover appear to be very small, and they are altogether indifferent about buying. Where business is to be done it is only at the lowest possible prices, and makers have either to gradually come down to the minimum rates, or allow the few orders that are being given out to pass them. Local makers of pig iron, who for some time past have been undersold by district brands, have had to give way a little upon their quoted rates, and in the finished iron trade there is a want of firmness when there are anything like good specifications to be got.

The Manchester iron market on Tuesday was tolerably well attended, but there was again an absence of any weight of business offering. For pig iron there was extremely little inquiry, and where any business was done it was on the basis of about 41s. to 42s. less 2½ for both local and district brands delivered equal to Manchester. Some of the makers are not disposed to come quite so low as this, but where more money is asked sellers are practically out of the market.

Some of the finished iron makers report rather more doing, but the actual trade offering generally continues very small. The exceptionally hot weather has caused a stoppage of work at some of the forges, and others find a difficulty in securing orders to keep them going even on short time. Prices remain much the same, except that perhaps £5 12s. 6d. is taken more readily for good qualities of Lancashire and North Staffordshire bars delivered into this district, and there are some of the local brands which might be got for a little less.

In the brassfoundry and coppersmith trade a slackening off is reported in some departments, but generally work keeps fairly steady, and for locomotive fittings there is a good demand, fairly large orders for copper locomotive plates having been given out recently. For general engineers' fittings the inquiry is only moderate, and prices are cut very low.

Locomotive builders in this district are tolerably well off for orders, and two of the largest firms, Messrs. Beyer and Peacock and Messrs. Sharp, Stewart, and Co., have, I understand, just now rather a pressure of work in hand, representing about twenty-five to thirty locomotives per month that these two firms will be turning out for some time to come.

Tool makers and machinists are kept tolerably well employed; marine engineering, however, continues very quiet, but there are indications of some revival in this branch of industry, orders, which, I hear from good sources, amount to nearly 150,000 tons, having recently been given out to the shipbuilders on the Clyde.

Last week I gave an abstract from the monthly report of the Steam Engine Makers' Society as to the state of employment in the engineering trades; to this I may now add a summary of the reports issued by the Amalgamated Society of Engineers and the Ironfounders' Society. The returns of the Amalgamated Society of Engineers show a slight increase in the number of unemployed throughout the country, about 4 per cent. of the members being now on the books in receipt of out-of-work donation. In the Lancashire district, however, employment continues steady, and in the Manchester and Salford district there is a very slight decrease in the number of out-of-work members. Pattern-makers are in better demand, and the number of members on the books in receipt of donation benefit does not exceed 3½ per cent. The secretary of the Ironfounders' Society reports a decrease in the number of unemployed members, the returns showing that out of a total membership of 12,247 there are now 775 members in receipt of out-of-work support, as compared with 883 last month. The branch reports as to the state of trade are, however, not of a very satisfactory character, and with the exception of Manchester, Oldham, and Halifax, there are no important districts in which trade is returned as good; bad, dull, or moderate being the general tenour of the large proportion of the reports.

The London and North-Western Railway Company has introduced a system of electric lighting in its fast express service between Liverpool and Manchester. The wires are led through the train in the usual way, and the lamps are joined up in multiple arc. Two lamps are provided for each compartment, one lamp being a reserve, and by means of a novel switch arrangement, if one lamp fails, the other is brought automatically in connection with the electric current. The locomotive is provided with a resistance switch, upon which is fitted a pilot lamp, that not only gives a light to the engine-driver, but acts as an indicator of how the lamps in the train are burning. The lamps used are the Swan incandescent, 20-candle power, and the system so far has worked very successfully.

The coal trade of this district continues extremely quiet. House fire coals are exceptionally bad to sell; the common qualities meet with only a very moderate demand for iron-making and steam purposes, and engine fuel still shows no scarcity, notwithstanding the present very limited production of slack. All descriptions of round coal are more or less of a drug in the market, and with pits not working more than three to four days a week, stocks are accumulating. Quoted rates are without any very material change, and generally there is a disposition rather to work short time than attempt to force business at excessively low rates; but still there is an anxiety to sell which produces a tendency to weakness in the market, and special rates are quoted for temporary sales to clear away stocks. At the pit mouth best coal averages 8s. 6d. to 9s.; seconds, 6s. 6d. to 7s.; common house fire coal, 5s. 6d. to 6s.; steam and forge coal, 5s. to 5s. 6d.; burgy, 4s. 6d. to 5s.; best slack, 4s. up to 4s. 6d.; and good ordinary qualities, 3s. 6d. to 3s. 9d. per ton.

The demand for shipment has been only moderate, with Lancashire steam coal delivered at the high level, Liverpool, or the Garston Dock, to be got at 7s. 3d. to 7s. 6d. per ton.

Barrow.—Some improvement is noticeable in the hematite iron trade this week, and the requests of consumers for lower prices have been firmly resisted. Very few orders are received on foreign account, but an improved business is done for home, and stocks are being gradually reduced. Some large orders have been received for Bessemer and forge iron, and the thousands of tons of stock which for months past have been lying in the yards or at the wharves are growing "beautifully less," in the fullest sense of the description. Several furnaces, in spite of the improvement, have been put out of blast. Most of the orders are being supplied by shipment, the returns of local railways showing that they are carrying little of the raw or manufactured material. Quotations have undergone no change, but heavy orders for forward delivery have been declined at present rates. The steel trade is quiet, very few new orders having come to hand, and works being mainly employed in executing orders for forward delivery. In the special steel trade little is doing. The shipbuilding trade, after being almost at a standstill for many months, has felt a slight recovery, and orders for sailing vessels of large size have been obtained. Iron ore is selling at from 8s. 6d. to 9s. 6d. per ton net at mines, but the enormous stocks are slow in undergoing reduction. Coal and coke in slight demand, with prices tending in favour of buyers.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

July, as the first month of the second half of the year, has a special interest in trade returns; but, so far as Sheffield productions are concerned, there is the same story to be told of decreasing exports. In hardware and cutlery the value sent abroad last month was only £268,938 as compared with £316,939 and £351,416 for July 1883 and 1884. Germany, Holland, Argentine Republic, and British Possessions, are the markets which show an improvement. Russia, France, Spain, and Canaries, United States, Foreign West Indies, Brazil, British North America, British East Indies, and Australasia, have all done less business, the greatest falling-off being in Brazil, which for July, 1882-3-4, shows a steady "drop"—£25,440, £21,801, £11,159. The decrease on the seven months is even more telling, the value for the seven months of this year being £1,857,224, and for the corresponding period of last year £2,219,178.

In steel rails Russia is again a customer of some consequence. In July, 1882, the value sent to the country was only £810; not a rail was sent all last year; but in the month which has just expired the value is £17,867. Germany, after doing nothing for two years, takes a small parcel—£223; while Spain and the Canaries for July of 1882-3-4 show the curious total values of £800, £9751, and £9 respectively. Nor is Italy anything to be proud of. In July, 1882, we exported to that country a value of £54,858; in July, 1883, the value dropped to £19,993; and last month to £8083. Egypt, after a two years' blank, has £2955. For the three months mentioned the United States' figures are very discouraging, viz., July, 1882, £121,052; July, 1883, £28,255; July, 1884, £18,708. Mexico, in the same period, shows respective totals of £39,732, £19,390, and £606. Chili took only £42 worth of steel rails in July, 1882, and £164 in July, 1883, but last month the value was £14,485. British North America has increased from £70,704 to £80,410; but British Possessions in South Africa betray a lamentable falling-off. In July, 1882, they took steel rails to the value of £38,782; but in July, 1883, the value was only £476; and last month it was still further attenuated to £78. British East Indies has increased from £27,525 to £39,720.

For steel the totals are even more unsatisfactory, the values for the last three years being £176,449, £112,235, and £93,759. The United States demand has steadily dropped during the three years—July, 1882, £97,225; July, 1883, £32,737; and July, 1884, £23,590.

The plant and machinery at the Charlton Ironworks have passed under the hammer this week. Metal sold at £1 15s. 10d. to £3 per ton, and iron £3 to £11 10s. per ton. A six-ton steam hammer, by Davy Brothers, with bed-plate, &c., sold for £169; a six-ton steam hammer, by Davy Bros., sold for £140; a pair of double-headed shears and engine, with 10in. cylinder, by Davy Brothers, sold for £75; and a large plate shear and engine, with 13in. cylinder, and scrap shears connected, by the same firm, fetched £210. A pair of high-pressure horizontal link motion engines, with gear and winding gear and hoist, and a large wrought iron blast furnace, 60ft. high by 20ft. diameter, with the retorts, hot stove, and piping, were sold together for £400. A horizontal high-pressure engine, with a 24in. cylinder, 5ft. stroke, and one blowing cylinder, 5ft. 6in. in diameter, and with bed, realised £185; and four wrought iron Cornish boilers and fittings, with double flues and cross tubes, sold for £40 each. Six furnace egg boilers fetched £23 10s. each; and a nest of three boilers, 36ft. by 20ft., realised £10.

The rail-sent coal to London in July was 540,712 tons, or 56,602 tons less than in July last year. Messrs. Newton, Chambers, and Co., Thorncliffe, again head the list with 24,267 tons; Clay Cross come next with 21,531 tons; Grassmoor Colliery, 14,709 tons; Langley Mill, 14,594 tons; Sheffield Coal Company, 14,426 tons; Messrs. J. and G. Wells, Eckington, 13,239 tons; Aberdare Iron Company, 10,974 tons; Hucknall Colliery Company, 10,593 tons.

The excessive heat during the week has caused work at the furnaces, &c., to be exceedingly severe and trying, and in several instances, indeed, it has had to be abandoned. At the large ironworks and collieries owned by Newton, Chambers, and Co., Thorncliffe and Chapeltown, there is a considerable amount of work being done in heavy and light castings, the Thorncliffe brand of pig maintaining its high reputation amongst ironfounders and machinists, and the demand continues equal to the production of the furnaces. Not a few of our iron companies in this district would like to be in a similar happy position.

Mr. R. Schott, Consul for Belgium, intimates that the period during which applications may be made for space in the Antwerp Exhibition has been extended to the 1st of September this year.

At the annual meeting of the Midland Institute of Mining Engineers, held at Barnsley, the following officers have been appointed:—President, Mr. T. W. Jeffcock, C.E., F.G.S.; vice-presidents, Messrs. A. M. Chambers, C. E. Rhodes, and W. E. Garforth; Council, Messrs. G. J. Kell, W. Hunter, A. B. Southall, J. Gerrard, J. Nevin, C. Hodgson, T. Dymond, and W. H. Chambers; secretary, Mr. Joseph Mitchell, Barnsley.

Alderman Gainsford is determined not to rest satisfied with the resolution of the Sheffield Town Council, which practically excludes traction engines from being worked in the borough during the day. He has asked the Local Government Board that he may be heard against the bye-law which the Council propose to put in force subject to the permission of the superior authority.

Messrs. J. J. Saville and Co., of Germania Works, Leadenhall-street, and Yorkshire Works, Napier-street, have obtained the gold medal at the Crystal Palace International Exhibition for their display of steel, files, and mill tools. Mr. John Greenhough, of Chintock Works, Milton-street, has received the gold medal for his exhibit of spring cutlery.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

There is no perceptible improvement in the Cleveland iron trade. Consumers evince no disposition to purchase; and although at the market held on Tuesday merchants were offering to sell No. 3 g.m.b. at 36s. 6d. to 36s. 9d. per ton, they had scarcely any success. Makers within the combination were as firm as ever to their regulation price of 37s. per ton. Deliveries of forge iron have been larger during the last few days, and prices are no lower than reported last week, viz., 35s. to 35s. 6d. per ton.

Warrants are offered at 36s. 6d. per ton, but buyers are not forthcoming. The stock of Cleveland pig iron in Connall's store at Middlesbrough was 56,511 tons on Monday last, being a reduction of 215 tons for the week. Their stock of pig iron at Glasgow is also decreasing. The quantity held on Monday last was 586,905 tons.

August shipments of pig iron from the Tees amounted to 26,144 tons on Monday last, as compared with 28,911 tons during the corresponding portion of June.

In the finished iron trade the outlook is as gloomy as ever. Next week most of the works will be closed for Stockton races. There are rumours that some orders for vessels have been placed on the Wear, but confirmation is needed. Similar rumours with respect to Clyde shipbuilding yards turn out to be only partially true, and little, if any, benefit is likely to accrue to this district. Quotations for finished iron are unaltered, ship-plates being still offered at from £5 to £5 2s. 6d. per ton, angles at £4 15s. to £4 17s. 6d., and common bars at £5 2s. 6d. to £5 5s., all free on trucks at makers' works, less 2½ per cent. discount. The bar iron trade is scarcely so brisk as it was.

The new steel works at Tudhoe, belonging to the Weardale Iron and Coal Company, were started on Wednesday, the 7th inst. The plant comprises two regenerative gas furnaces adapted for the manufacture of steel by the Siemens process. The gas is supplied by Wilson's patent gas producers made by Tangye and Co., of Birmingham. The plant also includes a powerful locomotive and crane combined, made by Dubs and Co., of Glasgow. The furnaces are each capable of producing ten tons per twelve hours.

Notwithstanding that Messrs. Allhusen and Co. failed to find salt at Port Clarence, another company is being formed to carry on boring explorations at Haverton Hill, on the north bank of the Tees, opposite to Middlesbrough. Mr. J. Vivyan has undertaken the superintendence of the operations.

Messrs. Bell Bros.' Page Bank Colliery, which has been closed about four months, owing to damage done by fire at the pit head, has been set to work again this week.

Messrs. Sadler and Co., of the Middlesbrough Chemical Works, gave notice last week to about 400 of their men of reduction of wages, varying from 15 to 25 per cent. Consequently, on Monday forty of the men came out on strike.

Messrs. B. Samuelson and Co.'s Slapewath mines have been closed, and will not be re-opened until trade revives. Many of the men affected are leaving the district, some of them having determined to emigrate to America.

The value of goods, exclusive of coal and coke, exported from Middlesbrough during July last amounted to £261,700. This is an increase of £57,693 when compared with July, 1883. Middlesbrough, it appears, stood higher than any other North-east port, Newcastle, which usually leads, having exported only to the value of £219,769.

The half-yearly meeting of the shareholders of the North-Eastern Railway has just been held at York. The dividend for the half-year will be 1 per cent. less than before, a result which is due to the falling off of the traffic owing to depression of trade. An attempt was made by a shareholder to induce the directors not to proceed at present with the Middlesbrough Dock extensions. He was, however, informed that the contract was let, and could not now be interfered with; besides which, the extensions were urgently needed, and would bring an ample return for the money expended. The only kind of travelling which showed a substantial increase was that in third-class carriages. Consequently the directors are wisely turning their attention towards treating this section of their customers at least as well as any other company does. It appears that great changes are being made in their locomotive building and repairing shops at Gateshead in order to bring them thoroughly up to date.

At the meeting of the Standing Committee of the Board of Arbitration to be held at Darlington on the 14th, the question of the re-establishment of a sliding scale will be considered. There is, however, not much chance of an agreement being arrived at, unless possibly by submitting the question to Mr. Dale, the standing referee. The employers are in no mood to pay more than 1s. 6d. above shillings for pounds, and the men have, as yet, shown no sign of again agreeing to receive payment in this proportion. At present ironworkers' wages are 2½ per cent. above what they would obtain under this scale, although as low as they have ever been in the North of England. The refusal of their comrades in Staffordshire to accept lower wages is, moreover, not likely to make the northern men more open to conviction.

Mr. A. J. Dorman, of the Britannia Ironworks, Middlesbrough, still lies dangerously ill. It is now said his illness is due to malaria, caught at Malta, where he went in the early spring for the benefit of his health.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THERE was a large amount of business in the Glasgow warrant market towards the close of last week; but on Friday the market became quieter, and continued so during the greater part of the present week. It is understood that bear accounts are remarkably heavy, and some reports of a greatly exaggerated description with reference to the Clyde shipbuilding trade led to a number of speculative operations. The quotations subsequently fell to a lower figure than before, and there has been much less business doing within the past few days. The shipments of pig iron from Scottish ports in the past week amounted to 9727 tons, against 9544 tons in the preceding week, and 14,056 tons in the corresponding week of 1883. The quantities despatched to the United States and Canada are rather larger than of late, but the inquiries from other countries are somewhat disappointing. There are ninety-five furnaces in blast, as compared with 114 at this date last year. The stock in Messrs. Connal and Co.'s Glasgow stores has decreased about 650 tons since last week.

Business was done in the warrant market on Friday at 41s. 5½d. cash. On Monday forenoon transactions took place at 41s. 5d. to 41s. 5½d. cash, and in the afternoon at 41s. 5½d. to 41s. 6d. cash. Tuesday's market was flat, with business at 41s. 5d. to 41s. 4d. and 41s. 4½d. cash, and 41s. 5½d. to 41s. 6d. one month. Business took place on Wednesday from 41s. 5½d. to 41s. 7d. cash, and to-day — Thursday — transactions occurred at 41s. 7d. to 41s. 6½d. cash.

The values of makers' iron are for the most part unchanged, but one or two brands are a shade higher. The quotations are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 51s. 6d.; No. 3, 49s. 9d.; Coltness, 57s. 6d. and 51s.; Langloan, 53s. 6d. and 51s. 3d.; Summerlee, 50s. 6d. and 47s.; Calder, 51s. 6d. and 46s. 9d.; Carnbroe, 50s. and 46s. 6d.; Clyde, 48s. and 45s.; Monkland, 43s. 6d. and 40s. 6d.; Quarter, 42s. and 40s. 3d.; Govan, at Broomielaw, 42s. 6d. and 40s. 6d.; Shotts, at Leith, 51s. 6d. and 51s.; Carron, at Grangemouth, 48s. (specially selected, 54s.), and 47s. 6d.; Kinneil, at Bo'ness, 44s. and 43s.; Glengarnock, at Ardrossan, 50s. and 43s.; Eglinton, 44s. and 40s. 6d.; Dalmellington, 46s. 9d. and 42s. 6d.

The general ironfounding trade in Glasgow and the neighbourhood has for some time been well supplied with work, and this has been a fortunate thing, not merely for those immediately connected with that branch, but also for the makers of pig iron, who otherwise would have had a worse market. Tube makers, except in a few instances, are steady; but there is a fair amount of work being done in connection with the manufacture of gas and water pipes, the prices of which are at present very moderate. At Edinburgh and Dalkeith the moulders at several foundries have been on strike against a reduction of wages, which, the employers explain, only reduce them to the rates current in similar works in the locality. There are a great variety of water and drainage schemes in progress in Scotland just now, and the probability is that the pipe trade will be busy during the remainder of the year.

There is still a good shipping demand for coals, the quantities despatched from Glasgow being particularly satisfactory. At Ayr the week's shipments were 7989 tons, and at Grangemouth 9888 tons were despatched. The Lanarkshire prices are without material change. For the better qualities of coal a slight improvement is noted in the quotations at Burntisland, which now are 6s. 9d. to 7s. 3d. f.o.b. per ton.

The secretary of the Fife and Clackmannan Coalowners' Association has written to Mr. Weir, the miners' secretary in that district, expressing regret that the representatives of the men have not thought fit to accept the proposals made for a sliding scale of wages. The basis of the scale is the present rate of pay, but the men desire to have it arranged on a past rate, the first result of the adoption of which would be to give the miners an increase of wages. It is to be hoped that a scale will be adjusted, so that the continual differences which have marked the relations of employers and workmen in the two counties may in future be avoided.

The Glasgow and South-Western Railway Company has this week begun the running of mineral trains at a cheap rate from the Hamilton district to the ports of Ayr, Troon, Irvine, and Ardrossan, the rates being the same to each of these harbours. The object of the arrangement is no doubt to anticipate the facilities to be offered by the proposed Lanarkshire and Ayrshire Railway, to which reference was made here last week.

WALES & ADJOINING COUNTIES.

(From our own Correspondent.)

SOME of the industries of Wales are at present in striking contrast to others. Such, for instance, is the utter stagnation in the iron and steel works, that projected improvements, extensions, and openings are suspended, and only the most necessary work is done. From Dowlais to Ebbw Vale the slackness of trade is very apparent, and I am surprised that there is not a reduction in the number of mills and furnaces. This must follow, if a speedy change does not set in. I noticed, too, from the Rhondda to Cardiff Docks, this week, a lessening in the coal output and traffic, and I learn that the market is not so firm. The large coalowners, of course, hold important contracts; but outside of these the sale is slackened. Figures show this in a remarkable manner. For instance, last week the exports of coal from Cardiff only amounted to 106,773 tons, but the week previously they totalled 145,000 tons. A falling-off to the extent of 40,000 tons can but show itself. Still, I am in hopes that the Bank Holiday had something to do in causing this. The best demand at present is best steam and best steam small.

In patent fuel, again, and in tin-plate there is a good deal of briskness, and the make is large and sale ready. With the steady improvement in tin-plate most of the old works are beginning to figure again—Briton Ferry, for example, much to the satisfaction of the people, where Mr. Davey has long been the preserver, in an industrial sense, of the district.

Cyfarthfa Steel Works are in an advanced stage, but the stimulus to start is a weak one. This week, however, the energetic proprietary started one of the old puddling forges, and thus added 100 more men to their working staff.

I am sorry to hear that the Ynysyfeio Colliery, Rhondda Valley, which employs 400 men, is idle, on account of the dangerous character of the upcast shaft, which is under repair. The men were all paid off on Monday, and received a certificate to enable them to work elsewhere.

Another bit of good news comes from the Garw Valley, one of the future great coal stores of Wales. At the Llest Colliery the No. 3 Rhondda has been struck, 3½ft. thick, of excellent quality, and great extent.

It transpired at the Taff Vale Railway meeting in Bristol this week that for some time this fortunate line of rail has only been paying £200 a year for damages!

The Gelly Colliery case, tried at Swansea this week, has excited a good deal of interest. This was a claim for compensation under the Employers' Liability Act. The plaintiff, widow of one of the sufferers, pleaded by evidence and counsel that the pit was fiery, and that an explosion had followed on account of neglect. After a good deal of conflicting evidence, which elicited from the judge the remark that someone was committing perjury, a verdict was entered for Mr. Griffiths and friend the proprietors of the colliery.

Local opinion is confident as to the future of Swansea as a port, and I note that even when slackness prevails at Cardiff and Newport, Swansea, with its good coasting trade and its large tin-plate and patent fuel business, is invariably brisk. It is also very evident that instead of sending its tin-plate cargoes to Liverpool, Swansea is doing a direct business with the States, and the impression is strengthening that more business of other kinds will follow. Swansea has a large background of coal, and with its direct connection with the Rhondda, its future as a port must steadily increase in prosperity. Swansea men look on the local strife of Cardiff with a good deal of wonder, and the suicidal policy of Cardiff shipowners and coal merchants in opposing the Marquis of Bute, and creating another Cardiff twelve miles away, led one of the leading men of Swansea to say lately:—"I wish we had a Marquis of Bute. We only want such another to satisfy us and make us prosperous."

The report of the Swansea Bay and Rhondda Railway is hopeful. It is expected that the line from Cymmer to Cwmavon in the Afan Valley will be ready by the autumn.

The visit of the Mechanical Engineers was an interesting one, and at the Severn Tunnel, which excited great interest, Mr. Walker invited them to a luncheon.

THE CHESTERFIELD AND DERBYSHIRE INSTITUTE OF MINING, CIVIL, AND MECHANICAL ENGINEERS.—This Society will make an excursion to Birmingham and neighbourhood on the 4th and 5th of September. An interesting programme has been arranged, containing enough to last nearly a week instead of two days.

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.

5th August, 1884.

10,912. DOUBLE CINDER SCREEN, J. Green, Sheffield.
10,913. CLOTH PLAITING, &c., MACHINES, C. and A. Edmeston, Salford.
10,914. SEAMLESS CLOTHING, J. and S. Law, Cleckheaton.
10,915. LETTING-OFF APPARATUS of LOOMS for WEAVING, H. Lomax, Darwen.
10,916. COMBINED REAPING, &c., MACHINES, H. J. H. King, Newmarket.
10,917. PULLEY BRAKE BLOCK, D. P. M'Niven, Hendon.
10,918. WRITING and READING MACHINE, &c., T. Scaife, Bradford.
10,919. MAKING and BREAKING CIRCUITS in SECONDARY BATTERIES, J. S. Beeman, London.
10,920. VELOCIPEDE SADDLES, J. B. Brooks, Birmingham.
10,921. GRINDING TWIST and OTHER DRILLS, A. Shirlaw, Birmingham.
10,922. CONTINUOUS PRESSURE of ENSILAGE in SILOS, T. Potter, Alresford.
10,923. ELECTRICAL CONNECTOR, J. S. Beeman, London.
10,924. OVENS or KILNS, A. J. Eardley, E. Meir, W. H. Bratt, R. H. Parker, and G. Hammersley, Dalehall.
10,925. FACILITATING the APPLICATION of CHALK to BILLIARD CUES, K. Beresford, Dover.
10,926. BOBBIN-WINDING and TENSION ATTACHMENTS for SEWING MACHINES, W. P. Thompson.—(*C. and C. Mickling, New York, U.S.*)
10,927. REMOVING DUST from FEATHERS, J. Martin, Liverpool.
10,928. COMBINED HAND and FOOT POWER for DRIVING SEWING MACHINES, &c., H. J. Allison.—(*C. Nicholson, Washington, U.S.*)
10,929. TABLE or WINDOW FOUNTAINS, J. Gilbert, Walsall.
10,930. PREPARING SILK FLOCK, A. Sauvée.—(*A. Baboin, Lyons, France.*)
10,931. ALARM LATCHES, A. C. Henderson.—(*O. Blanchot, Paris, France.*)
10,932. ALLOY for ELECTRICAL CONDUCTORS, H. H. Lake.—(*T. Shaw, Newark, U.S.*)
10,933. STEAMERS, &c., W. Simons, Renfrew.
10,934. CONTINUOUS BAR and HURDLE FENCING, W. P. C. Bain, Edinburgh.
10,935. CONTINUOUS BAR and HURDLE FENCING, W. P. C. Bain, Edinburgh.
10,936. MINING MACHINES, S. Stutz, Pittsburgh, U.S.
10,937. STEAM ENGINES, H. H. Westinghouse, A. G. Brown, and H. Tabor, Allegheny, U.S.
10,938. SAFETY FASTENER for ENVELOPES, B. J. B. Mills.—(*J. B. Vallet, Lyons, France.*)
10,939. ORNAMENTAL BOXES for SEWING THREAD, A. Brown, Lanark.
10,940. SECURING DOOR HANDLES to their SPINDLES, R. R. Parker, Dalmuir.
10,941. HOLLOW BOBBIN or REEL, H. J. Allison.—(*F. E. Vaquez-Vessart, Paris.*)
10,942. TOOL for EXTRACTING FERRULES from BOILER TUBES, H. Kellaway, Southampton, and A. Thomas, West Cowes.
10,943. MOSAIC WORK, L. E. Ascagne, Paris.
10,944. FIRE-ARMS, C. M. Bate, Newcastle-on-Tyne.
10,945. FEEDING CUTTING TOOLS to PLANING MACHINES, J. Barrow, Johnstone.
10,946. COATING NATURAL SHELLS with METALS, H. J. Haddan.—(*H. Piyot, Algiers.*)
10,947. HEATING or BOILING LIQUIDS, H. J. Worssam, London.
10,948. CORK FASTENER, R. Barlow, London.
10,949. HEATING ASPHALTUM, &c., A. H. Reid.—(*J. J. Schillinger, New York.*)
10,950. PHOTOGRAPHIC CAMERAS, A. H. Reid.—(*C. R. Smith, New York.*)
10,951. ELECTRIC LAMPS, G. Pitt.—(*C. Beck, Paris.*)
10,952. MATTRESSES, T. Capper, Northwich.
10,953. BUFFERS and BREAKS for VEHICLES, &c., G. B. Richards and A. Spencer, London.
10,954. CENTRAL GEAR TRICYCLES, W. J. Lloyd and W. Priest, Harborne.
10,955. PRODUCING COLOURED DESIGNS on LINOLEUM, F. J. Bolton, E. J. Hayball, and H. S. Cooper, London.
10,956. PRINTING DESIGNS on LINOLEUM, F. J. Bolton, E. J. Hayball, and H. S. Cooper, London.
10,957. PENCIL or CRAYON HOLDERS, A. J. Boult.—(*F. Hardtmuth, Austria.*)
10,958. STOPPING ROTATING ROLLERS, &c., N. Wilkinson, Nottingham.—*15th January*, 1884.
10,959. SLEEPER and FASTENING for RAILS, A. J. Boult. (*C. S. Westbrook, Washington, U.S.*)
10,960. MARINERS' COMPASSES, H. H. Lake.—(*J. Scotland and F. Cordon, St. Pierre.*)
10,961. GELATINE CAPSULES, A. M. Clark.—(*R. H. McCutcheon, New York.*)
10,962. SPINDLES for SPINNING MACHINES, H. H. Lake. —(*M. Chapon, France.*)
10,963. COMBINED FIRE ALARM and TIME DETECTOR, H. H. Lake.—(*J. A. Tilden, Massachusetts.*)
10,964. ELECTRIC BELL, H. Woodward, London.

6th August, 1884.

10,965. MECHANICAL TELEPHONES, H. H. Lake.—(*J. B. Bennett, Indianapolis.*)
10,966. CIRCULAR KNITTING MACHINES, A. C. Smith, Leicester.
10,967. DIRECT MANUAL ACTION GRIPPER WHEEL and AXLE GEARING for TRICYCLES, G. H. Thynne, London.
10,968. UNSTOPPERING INTERNAL STOPPERED MINERAL WATER BOTTLES, J. Jackson and E. Sunderland, Birmingham.
10,969. FLUID INJECTORS and WATER ELEVATORS, J. Hall, Manchester.
10,970. ENAMELLING SURFACE COLOURED PHOTOGRAPHS, F. Safe, London.
10,971. SOAKING PITS for STEEL INGOTS, J. Riley, Glasgow.
10,972. SPRING HINGES for CLOSING SWING DOORS, G. F. Newman, Birmingham.
10,973. FILTERING and PURIFYING WATER, &c., J. Carter, London.
10,974. LOCK JOINT for FISHING RODS, T. H. Izod and W. M. Jones, Redditch.
10,975. WATER PURIFYING APPARATUS, S. H. Emmens and the United Patents Corporation, London.
10,976. BRONZING, &c., PAPER, &c., R. F. Phillips, Manchester.
10,977. DEVICE for HOLDING the CORDS of WINDOW BLINDS, G. Sanford and D. Hearnshaw, Birmingham.
10,978. SAVING VALUABLES in SHIPWRECKS, H. C. Griggs, London.
10,979. TRICYCLES, &c., W. J. Lloyd and W. Priest, Harborne.
10,980. EXPLOSIVE PROJECTILE, A. M. Clark.—(*H. A. Shipp, San Francisco.*)
10,981. FACILITY CLARINET, A. Clinton, Newington.
10,982. AUTOMATICALLY OPENING, &c., GATES, H. V. R. Read, London.
10,983. STONE-BREAKING, &c., MACHINES, W. H. Baxter, Leeds.
10,984. CONSTRUCTING, &c., PEN NIBS, L. B. Bertram, London.
10,985. VELOCIPEDES, T. Lawson, Rochester.
10,986. EXPLOSIVE COMPOUND, T. Wilkins. — (*T. Petry and O. Fallenstein, Düren.*)
10,987. FINISHING GLASS STOPPERS, J. G. Liversidge, Leeds.
10,988. BATTENS and SHUTTLES, J. T. Cooke and J. L. Bottomley, Prestwich.
10,989. SCREW FANS, C. S. de Bay, London.
10,990. TELEPHONY, C. Langdon-Davies, London.
10,991. LUBRICATION of PULLEYS, R. H. Shaw and A. Greig, Leeds.
10,992. BREECH-LOADING ORDNANCE, J. Vavasseur, London.
10,993. ADJUSTABLE SPANNER, G. F. Roden, Shoeburyness.
10,994. FIRE-ESCAPES, &c., A. L. S. Leighs, Deptford.
10,995. PREVENTING RUST on METALS, T. J. Prout, Plymouth.
10,996. RELAY APPARATUS for TELEGRAPHS, C. D. Abel.—(*J. Kolzer, Duisburg, Germany.*)
10,997. DRIVING SEWING MACHINES, J. Muench, Kaisersautern, Bavaria.
10,998. GENERATING BLEACHING GAS, W. F. Shand, London.
10,999. JOURNAL LUBRICATORS, F. Faunt, London.
11,000. RAILWAY TUNNELS, H. H. Lake.—(*R. R. Hazard, New York.*)
11,001. SCRAPING TUBES, J. Murray, Glasgow.
11,002. MAKING RED AZO-DYE-STUFFS, &c., F. Gayes, Prussia.
11,003. SCHOOL FURNITURE, G. Wood, Leeds.
11,004. STEERING, &c., SHIPS, S. Barber, London.
11,005. TURNING OVER SHEETS of MUSIC, H. H. Lake. —(*H. B. Lindborg, Gefle, Sweden.*)
11,006. MAKING WHEEL TIRES, H. H. Lake.—(*J. C. Ollagnier, Paris.*)
11,007. POTASH SALTS, F. Brown, London.
11,008. CARBONATE of SODA, F. Brown, London.
11,009. BI-CARBONATE of SODA, F. Brown, London.
11,010. ARTICLE for DISCHARGING ORDNANCE, A. L. S. Leighs, Deptford.—*5th June*, 1884.

7th August, 1884.

11,011. CUFF-STUDS, &c., D. Bell, Great Harwood.
11,012. STEAM BOILERS, A. M. Taylor, Dumbarton.
11,013. DIFFERENTIAL WHEEL GEARING, J. H. Herbert, Wolverhampton, and B. P. Walker, Moseley.
11,014. RECORDING APPARATUS for GAMES, J. S. Whittington, Manchester.
11,015. MAKING NAIL-PLATES, T. Stanford and H. Payne, Birmingham.
11,016. COMBINATION of MATERIALS for MATS, &c., S. H. Sharp, Leeds.
11,017. FURNACE and FLUE SEAMS for BOILERS, S. Boswell, Salford.
11,018. TAPS for LIQUIDS, H. Cullabine, Sheffield.
11,019. RAILWAY RAILS, W. H. Andrew, Sheffield.
11,020. COMBINATION RUDDER, J. White, London.
11,021. RETAINING WALLS, A. Hübner, Cologne.
11,022. HOLDERS for NEEDLES, J. Holzgens, Rhenish Prussia.
11,023. MAKING SALT, G. S. Hazlehurst, Southlands.
11,024. PRINTING MACHINES, H. M. Nicholls, London.
11,025. FAUCETS, L. D. Craig, San Francisco.
11,026. BAG FASTENINGS, C. C. de Estaing, New York.
11,027. RAILWAY SLEEPING CARS, W. W. Fessler, New York.
11,028. LIFTS, P. M. Justice.—(*The Tewksbury Automatic Elevator Company, Incorported, New York.*)
11,029. FUSIBLE PLUG, J. C. Howell, London.
11,030. PREPARING COLOURING MATTERS, J. H. Johnson.—(*H. Caro, Mannheim.*)
11,031. ILLUMINATING COAL MINES, J. A. Ewing and T. Reid, Dundee.
11,032. STAITHS, S. Butler, London.
11,033. SHEARS, W. E. Gedge.—(*W. F. Wickenden, California.*)
11,034. STRAIGHTENING, &c., WOOLLEN, GARMENTS, E. de Pass.—(*A. Lyon, Paris.*)
11,035. CHLORINE and HYDROCHLORIC ACID, W. Weldon.—(*A. R. Pechiney et Compagnie, France.*)
11,036. CHLORINE, W. Weldon.—(*A. R. Pechiney et Compagnie, France.*)
11,037. INDIGO VATS, &c., F. W. Renaut.—(*C. Colin and L. Benoist, Paris.*)
11,038. MOTORS DRIVEN by WATER, F. Jenkin, Edinburgh, and H. Darwin, Cambridge.
11,039. SECURING FLEXIBLE DIAPHRAGMS in CYLINDERS, R. R. Gubbins, London.
11,040. COKE OVENS, A. F. Link.—(*T. Bauer, Bavaria.*
11,041. ROOFING TILES, S. Lawrence, Butleigh.
11,042. WIRE ROPES, H. H. Lake.—(*C. C. Colby, Canada.*)
11,043. TYPOGRAPHICAL PLATES, H. H. Lake.—(*S. Krakow, Paris.*)
11,044. FIRE-BLOWERS, C. Lee, London.
11,045. LOCKS for CARRIAGE DOORS, J. Edwards, London.
11,046. STEAM WHISTLE, A. M. Clark.—(*J. Einig, U.S.*)
11,047. FLOATING RECEPTACLE, A. M. Clark.—(*D. Sinclair, Wellington, New Zealand.*)
11,048. SCREW PROPELLERS, J. Paley, Glasgow.
11,049. INKSTANDS, W. Candland, London.

8th August, 1884.

11,050. IRON BARS for FIREPLACES, R. Schomburg, London.
11,051. STEAM GENERATORS, J. Blake, Manchester.
11,052. BREAKING or CRUSHING STONE, &c., T. Archer, jun., Gateshead.
11,053. PENTAGRAPH ENGRAVING MACHINES, J. Adam, Glasgow.
11,054. FIXING CORRUGATED IRON ROOFING, J. Rickard, Cornwall.
11,055. SHACKLE for TIGHTENING WIRES, G. Porter and W. Beattie, Manchester.
11,056. COMBINING with a FOLDING or RIGGING MACHINE LAYING DOWN or PLAITING MOTION and a ROLLING MOTION, J. H. Riley and J. Downham, Bury.
11,057. AUTOMATIC VACUUM BRAKE APPARATUS, J. Gresham, Salford.
11,058. SPRING CLIP to FASTEN STAIR, &c., RODS, J. Jackson, London.
11,059. APRON for PROTECTING the FORK and LEGS against RAIN, &c., W. W. Watts, Dublin.
11,060. FAÇONNEUR, C. Lehofer.—(*F. Fodany, Vienna.*)
11,061. MECHANICAL MOTION, J. B. Adams, London.
11,062. ILLUMINATED FOUNTAINS, F. J. Bolton, London.
11,063. CORSETS or STAYS, W. H. & H. Röhrs, London.
11,064. PULLEY HEAD or ATTACHMENT, J. W. Porritt, London.
11,065. WATER-CART, L. A. Groth.—(*F. and E. Stollar, Budapest.*)
11,066. INDICATING APPARATUS, T. Parker, Wolverhampton.
11,067. PORTABLE COOKING APPARATUS, J. C. Baxter, London.
11,068. BLOCK of LUCIFERS, A. L. A. Groschke and H. Hartjen, London.
11,069. PORTABLE SHELVES, S. Harris, Birmingham.
11,070. LAMPS, C. W. Torr, Birmingham.
11,071. CIGARETTES, A. D. Morris, London.
11,072. CYLINDERS and RIBBING DIAL PLATES of CIRCULAR KNITTING MACHINES, E. A. Abrahamson, London.
11,073. PULLEY SUPPORTS, H. J. Haddan.—(*M. Thomar, Bruxelles.*)
11,074. BIDETS, V. Count di Tergolina, London.
11,075. BEATING EGGS, CREAM, &c., W. P. Grafton, London.
11,076. NUT LOCKS, A. M. Clark.—(*J. C. M'Afee, U.S.*)
11,077. ENGINES, W. Lowrie, London.
11,078. ADJUSTABLE OFFICE TABLE or DESK, A. M. Clark.—(*W. Weishaupt, Frankfort-on-the-Maine.*)
11,079. PURIFYING FEED-WATER in STEAM BOILERS, H. H. Lake.—(*G. Stollwerck, Cologne-on-the-Rhine.*)
11,080. SHIPS, &c., J. M'Intyre, London.
11,081. BAND SAW MACHINERY, W. Brindley, London.
11,082. INDICATING to ANY PART of a SHIP the APPROACH of SHALLOW WATER, E. Larsen, London.

9th August, 1884.

11,083. CIGAR END-CUTTING and SQUARING MACHINE F. A. Rüther, Coventry.
11,084. FLEXIBLE BAGS, &c., T. Gates, Birmingham.
11,085. CARPET LINING, W. Mitchell, Manchester.
11,086. MOTORS, E. Butterworth, Rochdale.

11,087. Safety Paper, J. Jameson, Newcastle-on-Tyne.
11,088. Bottle-stopper, S. Davey, Birmingham.
11,089. Skewer Driver or Cutter, A. R. Strachan, Gateshead-upon-Tyne, and A. Cummings, Newcastle-upon-Tyne.
11,090. Oil Lamps, J. H. Ross and J. McVey, Dublin.
11,091. Watch-keys and Swivels, J. H. Summers, Birmingham.
11,092. Watch-keys and Swivels, J. H. Summers, Birmingham.
11,093. Watch-keys and Swivels, J. H. Summers, Birmingham.
11,094. Churn, G. Thomas, Kenwyn, Cornwall.
11,095. Stamping Jacquard Cards, J. Butler, Halifax.
11,096. Grease Traps, S. Cowan, Dalbeattie.
11,097. Consolidating Granular and other Particles, &c., into Solid Crystalline Blocks, &c., G. H. Ellis, Exeter.
11,098. Pipe Vices, J. C. Bauer, London.
11,099. Handles for Luggage Straps, J. C. Bauer. London.
11,100. Taps, D. H. Irwin, Withington.
11,101. Coupling between Engines and Carriages, C. J. Nicholson, Staffordshire.
11,102. Tramway Points, C. J. Nicholson, Staffordshire.
11,103. Propelling Tricycles, &c., J. Ellis, jun., Seacombe.
11,104. Extracting Oleaginous Matters from Bones, &c., L. and C. Steinmüller, London.
11,105. Steam Generators, L. and C. Steinmüller, London.
11,106. Measuring Electric Currents, Sir W. Thomson, Glasgow.
11,107. Tilting Device for Casks, &c., H. Whatton and J. Hughes, London.
11,108. Production of Raw Material for Asphalte Paving, &c., F. Bosshardt.—(*E. Dietrich, Berlin.*)
11,109. Extracting Fat, &c., from Bones, &c., W. Büttner, London.
11,110. Bolts or Fasteners applicable to Doors and Windows, G. T. Cleaton, London.
11,111. Kibbling and Pulverising Mineral and other Substances, &c., R. E. Shill, London.
11,112. Violins, J. and J. A. Taylor, Lower Edmonton.
11,113. Fireproof Armoured Curtains for Theatres, &c., J. and Ch. M. Rosenthal, Vienna.
11,114. Dressing or Finishing Cloth, J. C. Mewburn. —(*A. Vincent, Châteaubriant, and L. F. Pingrié, St. Germain.*)
11,115. Connecting the Carbon Filaments of Incandescent Electric Lamps to their Conducting Wires, C. D. Abel.—(*Messrs. Siemens & Halske Berlin.*)
11,116. Firebacks and Baskets of Portable Cooking Ranges, D. Wilson, London.
11,117. Taps for Drawing off Liquids from Bottles, &c., I. R. Sharpe, London.
11,118. Employing Rubber, &c., in the Faces of Excentric or Tightening Rings, E. Nunan, London.
11,119. Shirt Cuffs, A. F. Jack, London.
11,120. Condensation and Deposition of Particles of Metals, &c., Suspended in Air and other Gases, A. O. Walker, Chester.
11,121. Binders or Files for Letters, &c., H. H. Lake.—(*T. Hebert and Co., Paris.*)
11,122. Lace made by Machinery, P. Jensen.—(*A. and E. Henkels, Langerfeld.*)
11,123. Ferry Boats, N. MacNicoll, London.

11th August, 1884.

11,124. Effecting the Backing-off and Drawing-up of Self-acting Mules, &c., for Spinning and Doubling, J. Thompson and J. Wain, Manchester.
11,125. Fans to be used for Ventilating, &c., J. Lister, J. Whittaker, and J. Sheldon, Manchester.
11,126. Catching Lobsters, &c., W. C. W. Panter, Boscastle.
11,127. Chemical Manures, J. Mactear, Glasgow.
11,128. Citograph for Copying Maps, &c., W. Carter, jun., Glasgow.
11,129. Portable Exercising Machine or Mechanical Horse, G. H. Ellis, Exeter.
11,130. Spring Fastening for Solitaires, &c., A. J. Pettit, Birmingham.
11,131. Tricycles and similar Machines, J. Sawbridge and J. Blower, Birmingham.
11,132. Ordnance, G. Quick, Gloucestershire.
11,133. Thinning Turnips in the Drill, D. Briggs, Strathairby.
11,134. Ventilating Boots and Shoes, R. Baxter, Halifax.
11,135. Imitating Stained Glass Windows, S. H. Sharp, Halifax.
11,136. Intonation of Several Notes in the Scale of Flutes, &c., J. Sharpe, Leeds.
11,137. Revolving Knives, &c., of Carding Engines for Cleaning Wool, &c., J. Weaver, Preston.
11,138. Hydrostatic Automatic Valve and Piston Cocks, T. S. Truss, London.
11,139. Locking Nuts, H. B. Young, Barnstaple.
11,140. Rollers or Surfaces for Sharpening Knives, T. Salt, London.
11,141. Making Boots, &c., J. J. Gascoine and G. A. Royce, London.
11,142. Motor for Driving Tricycles, &c., D. Matthews and R. Taylor, London.
11,143. Lowering Sacks of Grain, &c., from Granaries, &c., C. T. Dennis, London.
11,144. Filters, G. Haycraft, Lyme Regis.
11,145. Incandescing Electric Lamps, B. J. B. Mills. —(*W. Holzer, U.S.*)
11,146. Electric Arc Lamps, A. E. Wadley, London.
11,147. Banjos, A. Tilley, Surbiton.
11,148. Water Meters and Indicators, W. H. Tooth, London.
11,149. Turbines, J. McConnell, London.
11,150. Engine Governors, A. A. Common, Ealing.
11,151. Appliances for Making Bricks, &c., J. Miller, London.
11,152. Aerated Water Pumps, F. Foster, London.
11,153. Pocket Chalice or Communion Cup, &c., A. M. Clark.—(*C. J. Curtis, U.S.*)
11,154. Elastic Metallic Packing, W. R. Oswald and J. R. Williams, London.
11,155. Mastic or Cement, S. P. Wilding.—(*J. Aubrey and G. de Vanssay, Paris.*)
11,156. Coupling Apparatus, H. H. Lake.—(*E. H. Janney, U.S.*)
11,157. Lamps for Burning Petroleum, &c., H. H. Lake.—(*C. J. Pigeon, Paris.*)
11,158. Making Glass Tumblers, &c., T. Walton, London.
11,159. Colouring Matters, J. H. Johnson.—(*H. Caro, Mannheim.*)

ABSTRACTS OF SPECIFICATIONS.

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

5510. Automatic Detaching and Safety Attaching Gear for Ships' Boats, *J. Dixon, M. Waddle, Blyth, E. Marshall, North Shields, and R. Dawson, Blyth.*—24*th November*, 1883. 6*d*.
Relates to apparatus for automatically detaching ships' boats by contact with the water, and specially to means whereby the attaching to the tackles may be effected with absolute safety from the dangers incidental to one end being attached without the other, and the boat capsized and probably destroyed.

5569. Velocipedes, *P. Adie, London.*—29*th November*, 1883. 6*d*.
Relates partly to means for lowering the centre of gravity of the rider by the arrangement of the seat below the axles or wheels.

5600. Bicycles, &c., *H. Robin, Paris.*—3*rd December*, 1883.—(*Not proceeded with.*) 4*d*.
Relates to the mode of suspending the seat behind and below the axles.

5746. Placing Cop Tubes upon Spindles, *J. B., G., and J. B. Swailes, Oldham.*—15*th December*, 1883. 6*d*.
Consists in turning the hook of the end of the spring inwards instead of outwards, dispensing with the wire staple, and cutting a notch in the wood of the frame for the turned-in hook of the spring to catch upon.

5757. Lithographic Printing Machines, *A. Paton, Leeds.*—17*th December*, 1883. 6*d*.
Relates to means of adjusting the inking apparatus of lithographic printing machines, and the guides for feeding the paper or card that is printed by them.

5803. Printing Machinery, *G. W. Osborn and D. W. Yates, London.*—18*th December*, 1883. 6*d*.
Relates to machines for printing continuous sheets of paper, such as paperhangings, with one or more colour, or with a colour or colours, and a mordant or mordants to receive leaf, such as gold leaf, and consists in means for ensuring a correct register.

5822. Winches, &c., *W. Clarke, Gateshead-on-Tyne.*—20*th December*, 1883. 4*d*.
Relates to the arrangement of brakes and a clutch for varying the speeds.

5825. Water-closets, &c., *J. Shanks, Barrhead.*—21*st December*, 1883. 4*d*.
Relates partly to the means of supplying the water to the closet.

5826. Springs in Carriages, *R. Croall, Edinburgh.*—21*st December*, 1883. 4*d*.
Relates to the adaptation and application to the front part of carriages as well as to the back part thereof of three-quarter elliptic springs and cross springs.

5833. Converting Continuous Rotary Motion into Step-by-step Rotary Motion, *C. D. Abel, London.*—21*st December*, 1883.—(*A communication from A. Kaiser, Freiburg.*) 6*d*.
Consists in the use for converting continuous rotary motion into step-by-step rotary motion of a toothed wheel operating in combination with a star wheel connected thereto by a spring.

5836. Oil Burners, *J. C. Morrison, West Ham, and R. Smith, Bromley.*—22*nd December*, 1883. 6*d*.
The object is to regulate and distribute the supply of air to the interior of the outer flame and to the inner flames.

5856. Printing Presses, *W. R. Lake, London.*—26*th December*, 1883.—(*A communication from T. S. Nowell, Boston.*). 8*d*.
Relates to a press especially adapted to printing upon wooden boxes after they are nailed together, or upon the boards from which boxes or other articles are to be made.

5860. Hair Pins, *A. G. Brookes, London.*—26*th December*, 1883.—(*A communication from H. G. Thompson, Milford, U.S.*) 6*d*.
Consists of a hair pin twisted to form a long spiral.

5865. Dynamo-electric Machines, *E. C. Warburton, Manchester, and L. J. Crossley, Halifax.*—26*th December*, 1883. 6*d*.
This relates to so constructing and connecting the armatures and field magnets that they shall rotate in opposite directions.

5870. Automatic Drain Flushing Apparatus, *W. Ross, Glasgow.*—27*th December*, 1883. 6*d*.
Relates to the employment in drain flushing apparatus of suckers or sucker valves, to effect automatically the operations of opening and closing the discharge outlet as the flushing tank is filled or emptied.

5893. Apparatus for Evaporating, Distilling, or Concentrating Liquids, *J. Imray, London.*—28*th December*, 1883.—(*A communication from H. Egells, Berlin.*) 4*d*.
Consists in the construction of apparatus for evaporating, distilling, or concentrating liquids, presenting between its successive compartments externally wedge-shaped pockets, into which jets of steam are directed so as to heat the liquid in its zig-zag descent.

5895. Spring Mattresses, *J. B. Rowcliffe, Glossop.*—28*th December*, 1883. 4*d*.
Relates to the arrangement of chains or wires and to springs.

5913. Tubular Lanterns, *T. Phillips, Orillia, Canada.*—29*th December* 1883. 6*d*.
Relates principally to the construction of the hinging device.

5916. Utilisation of Power derived from the Tide to Propel Railway Trains, &c., *E. G. Brewer, London.*—29*th December*, 1883.—(*A communication from L. M. Giustina, Milan.*)—(*Not proceeded with.*) 2*d*.
Relates to general arrangement of an apparatus for utilising the tide as the agency for producing a motive power to propel trains, &c.

5935. Repeating Fire-arms, *W. R. Lake, London.*—29*th December*, 1883.—(*A communication from A. Larsen and C. E. Winterros, Liege.*) 6*d*.
One feature of the invention consists in constructing an excentric lever of particular form. By depressing the said lever and bringing it back quickly, the empty cartridge is withdrawn, the fire-arm is cocked, and a new cartridge is inserted in the chamber. By pulling slightly the trigger, a solid striker, of a single piece, strikes the cartridge and explodes it. Other improvements are described.

5938. Coating Metal Plates with Tin, &c., *E. Morewood, Llanelly.*—31*st December*, 1883. 8*d*.
The inventor causes the plates as they emerge, or immediately after they emerge from the surface of the coating metal, to travel in such a path that their surfaces shall pass between washing rollers or appliances; and if these washing rollers or appliances leave the plates with a heavier or less perfect coating than is desired, he further subjects the plates to other rollers revolving in or in contact with flux, which reduce, improve, or give finish to such coating.

5940. Water-closets, &c., *J. C. Mewburn, London.*—31*st December*, 1883.—(*A communication from J. E. Boyle, Brooklyn, and H. Huber, New York.*) 6*d*.
Relates to flushing apparatus for water-closets wherein the descent of the flushing water is made to create a suction in order to syphon the bowl, the improvement consisting in the employment in connection with the air pipe of an ejector, through which the flushing water falls in such manner as to draw air from the air pipe.

5942. Lawn Mowing Machines, *G. E. Newton, London.*—31*st December*, 1883. 4*d*.
Consists in the substitution of plain metallic plates or knives for the circular revolving cutters now used.

5943. Slide Valve for Steam Engines, *H. Hovcaldt, Kiel.*—31*st December*, 1883. 6*d*.
The object is, by the peculiar construction of the slide valves for steam engines, to reduce the friction between the working faces of the valve, and of the slide faces of the chest-lid and of the cylinder, and to provide means for balancing it against one-sided steam pressure.

5949. Manufacture of Wall Decorations, &c., in Ornamental Relief, *F. Walton, Twickenham.*—31*st December*, 1883. 6*d*.
Relates to the arrangement of rollers.

5953. Self-feeding Eyeletting Machine, *C. Whitfield, Kettering.*—31*st December*, 1883. 6*d*.
Relates principally to mechanism for automatically feeding the eyelets, so as to prevent all risk of their jamming as now so frequently occurs.

5963. Refrigerators, *C. M. Sombart, Magdeburg.*—31*st December*, 1883.—(*A communication from B. Moebius, Chihuahua, Mexico.*) 6*d*.
Consists in refrigerators adapted to cool the contents of vessels by the vaporisation of liquids, absorbed by capillary attraction of fabrics placed round the vessel and partly in contact with the liquid to be evaporated.

5977. Regulating the Supply of Air to Furnaces, *W. C. Gale, Lower Tooting.*—31*st December*, 1883. 6*d*.
Relates to the employment of a bath of mercury placed inside of a chamber fixed on the outer side of the door, of a furnace for controlling the admission of air to the chamber.

5966. Effecting Intermittent Action of Fog and other Signals, *F. W. Durham and J. D. Churchill, London.*—31*st December*, 1883. 6*d*.
Relates to effecting the intermittent action of the signals by means of steam.

5981. Printer's Quoins, *J. C. W. Featherstonhaugh, London.*—31*st December*, 1883. 6*d*.
The quoin comprises a right and left-handed male screw with intermediate enlargement, and two cheeks or plates with parallel sides.

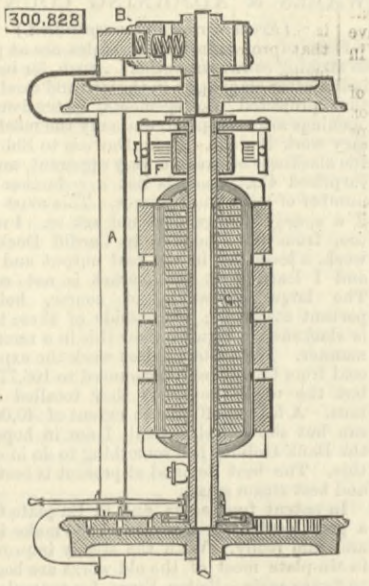
5992. Apparatus for Lighting Gas by Electricity, &c., *C. L. Clarke, Manchester.*—31*st December*, 1883. 6*d*.
This relates to an electrostatic generating arrangement made in a convenient cylindrical form, and combined with a drying cell containing a drying substance whereby the interior surfaces of the apparatus are kept perfectly dry.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

300,828. Electric Motor for Railway Cars, *A. Wellington Adams, St. Louis, Mo.*—*Filed December 15th*, 1883.
Claim.—(1) The combination, with the axle which carries the driven wheels, the axle boxes or bearings, and a frame secured to or formed in one with said boxes or bearings, of an electric motor whose armature is mounted to revolve on said axle, and whose field is attached to and carried by said frame, substantially as and for the purposes hereinbefore set forth. (2) The combination with the driven wheels, their axle and axle boxes or bearings, and a field-supporting frame secured to or formed in one with said boxes or bearings, of an electric motor whose armature and field are carried by said axle and frame, respectively, and intermediate motion-transmitting gear-

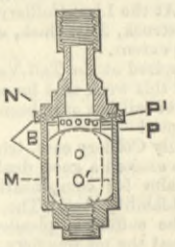
300.828



ing, also carried by said frame, and meshing on the one hand with a gear on the driven wheels and on the other with a gear on the armature hub. (3) The driven wheels, their axle and axle boxes or bearings, and the supporting frame secured to or formed in one with said boxes or bearings, in combination with the armature mounted to revolve on said axle, and the field-magnets, commutator brushes, and intermediate motion-transmitting gearing mounted in and carried by said supporting frame, under the arrangement and for operation as hereinbefore set forth.

301,124. Device for Preventing Percussion or Water-hammering in Pipes, *Francis Hyde, Toronto, Ontario, Canada.*—*Filed July 5th*, 1883.
Claim.—(1) A percussion chamber B, provided with a compression ball *o*, having longitudinal conduits o^1 in the periphery thereof, and placed in the chamber proper *m*, having a cover *n* combined with vessel *p*,

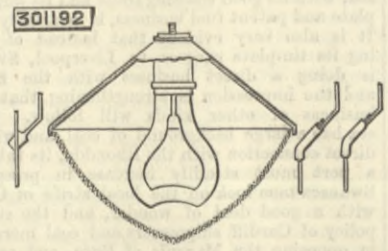
301,124



having orifices p^1, as shown and described, and operating as set forth. (2) A percussion chamber B, constructed with a compression ball *o*, acting in combination with taps or valves in water pipes under a pressure, substantially as specified and described.

301,192. Carbon for Incandescent Electric Light, *Nelson S. White, Canton, Mass.*—*Filed March 10th*, 1884.
Claim.—(1) A carbon filament for incandescent electric lights, coated with metal particles, substan-

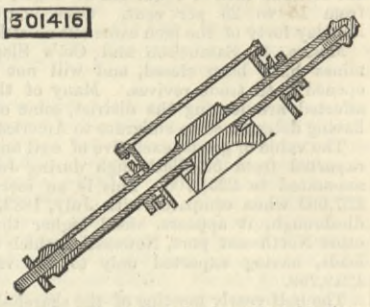
301,192



tially as described. (2) In a filament for incandescent lights, a body of carbon carrying upon its surface particles of metal adapted to be heated thereby, substantially as described.

301,416. Adjusting and Securing Slide Valves upon their Rods, *William E. Wiley, Grand Rapids, Mich.*—*Filed January 17th*, 1884.
Claim.—(1) The combination, with a steam chest, a valve rod, and valve adjustable thereon, of sleeves for clamping the valve on opposite sides, and nuts located outside of the chest for moving said sleeves, whereby the valve may be adjusted from the outside of the chest back and forth on the rod and tightened and locked to the rod, substantially as described. (2) The combination, with a steam chest, a valve rod, and valve adjustable thereon, of sleeves having enlarged ends bearing against opposite sides of the valve, and nuts located outside of the chest for moving said sleeves, whereby the valve may, from the outside of the chest, be adjusted back and forth on the rod and tightened and locked to the rod, substantially as described. (3) The combination of the steam chest, the slide valve formed with lugs, with a space between them for the passage of the valve rod, the rod, the sleeves encircling the rod with one end bearing against the lugs on the valve and the other end extending outside of the chest, and the screw nuts engaging with screw threads on the rod and bearing against the said sleeves, whereby the valve may, from the outside of the chest, be adjusted back and forth on the rod and tightened and locked to the rod, substantially as described. (4) The combination, with a

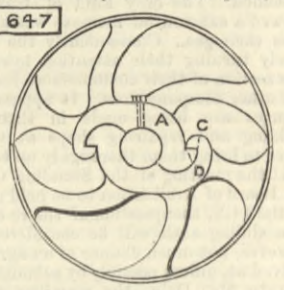
301,416



steam chest, a valve rod, and valve adjustable thereon, of clamps on opposite sides of the valve operated from the outside of the chest to move the valve back and forth on the rod and tighten it and lock it to the rod, substantially as described.

301,647. Split Pulley, *John A. Upham, East Brookfield, Mass.*—*Filed May 28th*, 1884.
Claim.—(1) A pulley consisting of two parts, each provided with hooks adapted to engage the other, and one part provided with set screws, substantially as shown and described, whereby the parts of the pulley are clamped together, by a force which tends to separate the main body of the two parts, for the

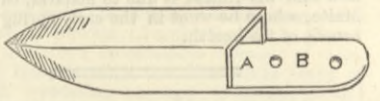
301,647



purpose specified. (2) The half pulley A, provided with hooks C and D, adapted to engage another similar half pulley, substantially as shown and described, whereby the joining of two such halves forms a pulley.

301,660. Tooth for Horse Hay Rakes, *Jacob H. Bean, Macon, Ill.*—*Filed March 19th*, 1883.
Claim.—(1) As a new article of manufacture, the improved metallic point for rake teeth, consisting of a single casting bevelled and pointed, as specified, and having the socket *a* and rearward-extending perforated tongue *b*, adapted, when the point is applied, to bear

301,660



beneath the wooden tooth at a point in the rear of said socket, substantially as set forth. (2) The combination, in a rake, of a series of teeth, each reduced or tenoned at its extremity, and a metallic point provided with a socket *a*, adapted to receive said reduced portion or tenon, and a perforated tongue-extension *b*, bearing against the under side of the tooth at a point in the rear of said socket, and secured thereto by means of screws or rivets, substantially as set forth.

CONTENTS.

The Engineer, August 15th, 1884. page

Sheaf-binding Machine Trials 117
The Institution of Mechanical Engineers .. 118
Boiler Corrosion 118
Letters to the Editor—
The Manchester Ship Canal 119
Water-tube Boilers 119
Railways of New South Wales 119
Prospects of Young Engineers 119
The late Mr. Manby 130
The late Mr. Massey Bromley 130
The Wilmslow Accident 130
Locomotive Crank Axles 130
Testing Iron by Magnetism 130
Covered Service Reservoirs, Matlock Bath Waterworks. (Illustrated.) 121
Trent Turbine in Mining Case. (Illustrated.) .. 121
Marine Engine Governor. (Illustrated.) 121
Smoke Abatement 122
Railway Matters 123
Notes and Memoranda 123
Miscellanea 123
Leading Articles—
The Downton Catastrophe 125
A Crowded City 125
The Prospects of Young Engineers 126
An Indo-European Railway 126
Coalowners and Coalgetters 126
Port Charges 126
L'Abbe Moigno 126
Foreign Notes 126
Petroleum Refuse as Locomotive Fuel 127
Steam Fire-engines at Osborne House. (Illustrated.) 128
Indigo Machine. (Illustrated.) 129
Duponchel's Overshot Water-wheels. (Illustrated.) 129
The Downton Catastrophe. (Illustrated.) 129
Repairing Cables of Alleghany Bridge 130
American Notes 131
The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and District .. 131
Notes from Lancashire 132
Notes from Sheffield 132
Notes from the North of England 132
Notes from Scotland 133
Notes from Wales and Adjoining Counties .. 133
The Patent Journal 133
Abstracts of Patent Specifications. (Illus.) .. 134
Abstracts of Patent American Specifications. 134
Paragraphs—
The British Association 119
Chicago Pumping Station 121
Metropolitan Water Supply 122
The Whitworth Scholarships 127
The Royal Scotch Show 127
Transatlantic Trade by Hudson's Bay 128

South Kensington Museum.—Visitors during the week ending Aug. 9th, 1884:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 15,903; mercantile marine, Indian section, and other collections, 9213. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m to 6 p.m., Museum, 1620; mercantile marine, Indian section, and other collections, 350. Total, 27,086. Average of corresponding week in former years, 34,910. Total from the opening of the Museum, 21,262,881.