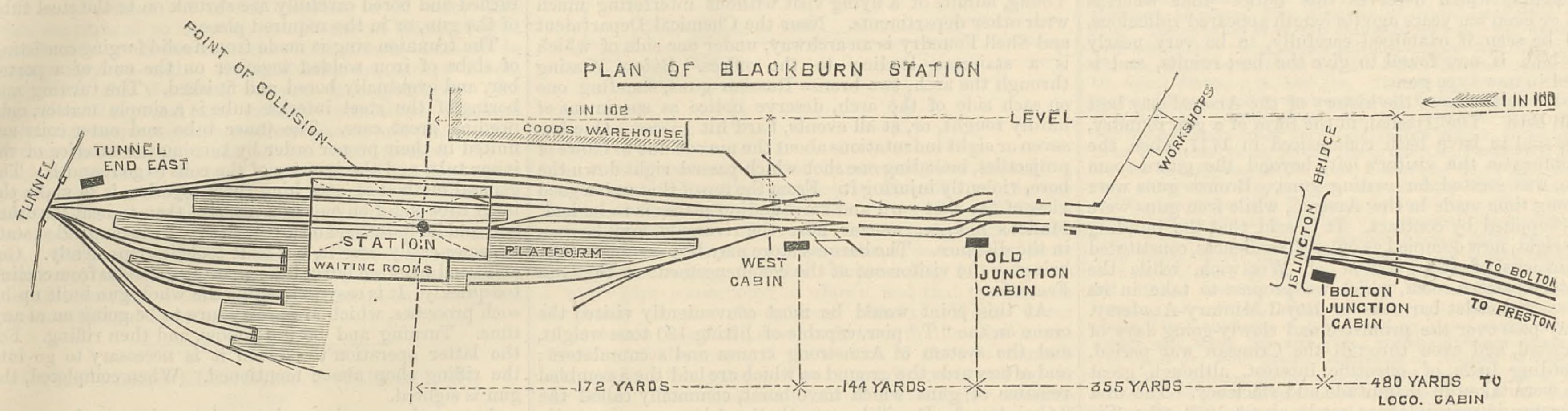
THE BLACKBURN RAILWAY COLLISION.

On Friday, the 16th instant, the coroner's inquest on the bodies of those killed in the Blackburn collision was brought to a close, the jury pronouncing the following verdict:—"We find that Charles Tiplady and others lost their lives in a collision between Manchester and Liverpool trains, in the Blackburn Station, on the 8th of August, 1881, and that such collision was caused by the loose working of the signals, and the excessive speed at which the Manchester train was being driven into the station, and the jury are further of opinion that there ought to be more protection to the station than the present system of signalling at the East and West Cabins afford." Furthermore Mr. Eatough, the foreman, in reply to the coroner, stated that the jury did not find that criminal blame attached to anyone. We have every reason to believe that the verdict is a very proper one, meeting all the circumstances of the case. The collision itself was of considerable importance, and much interest has been excited concerning it, because of certain issues which have been raised. Two inquiries have been carried on, one by the coroner, the other by the Board of Trade represented by Colonel Yolland. So long as the inquest was not terminated, it would have been obviously improper to say much about the matter. The same reticence is not of course called for by a Board of Trade inquiry. But that also terminated some time since, although Colonel Yolland has not yet made his report.

The facts are very simple. On the 8th of August the train which left Liverpool for Todmorden at 2.10 p.m., entered Blackburn station at 3.9 p.m. The train stopped with the engine just outside the roof of the station. The saloon carriage next the engine had to be left in siding No. 1—it was detached and run into the siding in due course. The engine then returned and was attached to its train; when just as the driver had opened the regulator to start the collision took place. While the engine drawing the Liverpool train was taking away the saloon carriage, as just explained, a shunting engine, the Vesuvius, came out of a siding, and was coupled on to a Midland bogie carriage at the end of and just detached from the Liverpool train. Had all gone right, as soon as the Liverpool train had got fairly away it would have been followed by the Vesuvius, pushing the bogie carriage before it, in order to put it for the moment on another siding. Consequently the Vesuvius and the Midland bogie carriage were at the end of the Liverpool train. Just as the train began to move, the Manchester express rushed into the station and dashed into the Vesuvius. The driver of the Manchester express, named Stansfield, and his stoker, Mark Barker, jumped for their lives just before the collision occurred. The Midland bogie carriage was smashed up, and much damage was done to the last carriage of the Liverpool train; the engines were not seriously injured. The Manchester express consisted of seven coaches—the first three were damaged, the last four were not. Seven persons were killed and many others severely wounded. Such are the prominent facts of the case.

The jury were quite right in stating that none of the companies' servants were guilty of criminal negligence. The accident was the result of not one but several causes, all contributing to the same end. The system of working the traffic was defective, and although it was stated in evidence that what was done by the signalman on the 8th of August had been done daily for seven years, we have no reason to doubt that very grave risks had been incurred during that period. An attempt was at first made to attribute the accident to the failure of the Westinghouse brake, with which the Manchester express was fitted; but the company did not tender evidence to prove that the brake was in fault. The driver and his stoker swore, indeed, that the brake would not act, but the former admitted on Friday that he had run with the brake himself only five times before, and that he had twice seen it worked by a fireman sent to instruct him; his experience with it therefore was extremely limited. Three passengers who were in the express stated that to the best of their knowledge the brakes were put on just before the collision occurred. The jury ignored the statement of the driver altogether, and the railway company apparently attached little weight to it. At all events, as we have said, they called no corroborative evidence. We may, therefore, dismiss assertions which have been made concerning the failure of the brake as mere rumour founded on the statements of the driver. The jury believed that the train was run at too high a speed, and those who are familiar with Blackburn Station will, we think, be prepared to admit that any speed save a very moderate velocity must be too great for entering it. The station is small and cramped, the approaches are inconvenient, and the sidings usually crowded. The distances to be traversed from signal to signal are very short, as will be seen from the plan above. Stansfield admitted that he had never before driven the Manchester express; and nothing was more likely than that he should lose his presence of mind and make a mistake. The defective feature in the signalling system was that the home signal was dropped at the West Cabin to let a train enter the station, no matter what its speed might be. Whether an accident would or would not occur depended entirely on the driver, and not at all on the rules. If our readers will turn to the plan, they will readily understand what took place. When the Liverpool train came in, the signalman, Robert Thompson, in the West Cabin, put his home signal at danger, and his distant signal also at danger. The Manchester train came from Bolton Junction, a distance of 671 yards from the point of collision. While the Liverpool train was, as we have stated, yet in the station, Thompson lowered his home signal to let the Manchester train run in, but he did not lower the distant signal. Under the absolute block system, the home signal could not be lowered while there was a train in the station, but the traffic through Blackburn is worked on the permissive block system. According to the 47th rule of the company's signal instructions, the driver must, on seeing the distant signal up, bring his train under perfect control. In other words, the distant signal if up must be passed at a slow speed. Under this condition the driver is permitted to enter the station, the home signal being lowered for him. The railway company, it appears, clearly understood that the lowering of the home signal was to depend on the speed at which the train passed the distant signal. But in practice it seems that the home signal was dropped, no matter whether the driver had or had not followed his instructions, and pulled up, or nearly pulled up, at the distant signal. According to one of the witnesses—W. Beconsall, who had instructed Thompson in the working of the signals at the West Cabin—when there was a train standing in the station, it was the duty of the signalman to keep his home signal on until he saw the train reduce speed so that it could stop if required. He instructed Thompson to that effect. The signalman would be justified in taking off the home signal and exhibiting a green flag if there was room for the second train in the station. There were constantly trains standing on the same line in the station before an approaching train, and the signalman allowed a second train to enter in, showing a green flag for caution. The next witness examined was Henry Smith, pointsman at the Old Junction cabin, and we reproduce his evidence because it bears strongly on the case. He said that the practice since he went to the cabin had been to lower the home signal at West Cabin, and let a train approach the station with a green flag when there had been a train in the station at East Cabin, the distant signals being kept on. According to Rule 260, Blackburn was one of the lines scheduled as a place where particular care was required on the part of the driver. He ought to bring his train under control independent of the distant signal.—Col. Yolland: When there is a train on the line between the West Cabin and the East Cabin, what protection is there for an approaching train if you don't put a stop signal somewhere or other to cause that coming train to pull up?—Witness: This protection—in bringing the train to a stand at the home signal, and then lowering it.—Col. Yolland: Exactly; that is another thing. But don't you, practically speaking, bring the train to a stand, or nearly so, before you take it off?—Witness: Yes, sir, at the Old Junction Cabin, if the West Cabin signal is on, we do.—Col. Yolland: Should not the West Cabin signalman do so?—Witness: Yes, sir, if he has any doubt as to the amount of room in the station.—Col. Yolland: It is not the amount of room only, but the amount of speed.—Witness: But he cannot tell from his cabin.—Col. Yolland: Are you not all told to bring the train to a stand, or nearly to a stand, before you take off the home signal?—Witness: We are told at the Old Junction to do so, in case the West Cabin is at danger.—Col. Yolland: And if the West Cabin box signalman takes off his home signal, all the protection is removed; if I understand the matter rightly from the rules of the Lancashire and Yorkshire Railway Company, that is the intention where the perfect block working is no longer absolute, that is between the Old Junction and the East Cabin. That is station working, permissive working?—Witness: Yes, sir, it is permissive block from our cabin to the East Cabin.—Col. Yolland: There is no safety whatever for the public in any case, if all the home signals were to be taken off from the Bolton Junction, the Old Junction, and the West Cabin. The next home signal is after the crash has taken place."

Now the driver, Stansfield, previously swore that what Colonel Yolland suggested really nearly took place—namely, all the signals were practically off for him. He stated that, after leaving Manchester, he first stopped at Bolton, with the automatic brake. He then passed through the Sough Tunnel, slowing down with the hand-brake and Westinghouse brake. He used the hand-brake to save air. He slowed down at the Over Darwen end of the tunnel—in which a large number of men are at work lowering the floor—and then pulled up at Over Darwen, the brake acting properly. The run from Darwen to Blackburn occupies about six minutes. After leaving Over Darwen Stansfield shut off steam "a little lower than the ironworks." The first signal he saw was that next the Locomotive Cabin. Distant and home signals were off. The next signal was that at Bolton Junction Cabin; that also was off. Next he saw the Old Junction signal on, and the home signal off. Thus it will be seen that the driver had but one signal against him, although there was a train in the station close before him, and that this signal was not treated as a stop signal but as a caution signal. Herein lies the weak part of the whole system. It is assumed that the signalman is not to lower the home signal unless he is certain that the train is quite under control at the distant signal; but, as Smith stated, the man in his cabin cannot tell at what speed the train passes the distant signal. In order to render the working of the traffic safe, it is evident, either that the home signal should not be lowered until the signalman is certain that the train has actually stopped at the distant signal, or, what would be much better, the train should be allowed to draw up to the home signal and there stopped, or nearly stopped, under the signalman's eyes, before being permitted to enter the station. In practice the signalmen at Blackburn never attempted to ascertain at what speed a train was coming into the station. It is clear that the railway company provided, as they thought, two factors of safety. In the first place, the driver was expected to stop, or nearly stop, at the distant signal; and in the second, the signalman in the West Cabin was expected not to lower the home signal unless he believed the train was perfectly under control. As a matter of fact, the home signal was lowered before the train was even in sight. It has long been known that it is impossible to secure safety unless good rules are rigidly enforced. If a signal at danger is never to be passed, the chances are that its intimation will always be obeyed and that no accident will occur; but when a driver is told that if certain conditions are observed the signal may be passed, an element of danger is at once introduced which sooner or later works mischief. It is only a question of time. It does not appear that any inconvenience would have accrued from rendering the stoppage of trains at the home signal imperative when another train was in the station. Such things are done daily in London at far more crowded stations than Blackburn. It is to be presumed that the Lancashire and Yorkshire Railway Company has learned a lesson which will not soon be forgotten, and no doubt the traffic will in future be worked on a better system than that practised during the past. Nothing could have been better, perhaps, than the intention of the company; but the fatal word "if" was admitted into their instructions. "If the train is under control the home signal may be lowered;" and so the good intentions of the company were useless. A very little more care and an accident would have been avoided. But this is always the case. The margin between safety and danger in working trains through crowded stations is very small, and in consequence comparative trifles assume large proportions. It is useless to prepare elaborate instructions for a signalman, and then permit him to disregard them.



WOOLWICH ARSENAL.

Among the places to be visited by the members of the Iron and Steel Institute, during their visit to London next month, is Woolwich Arsenal. These great Government works will be found to present much of extreme interest alike to the ironmaster and the mechanical engineer, and the following article has been prepared with a special view to indicate what those who visit Woolwich may see. Indeed, a need appears to be felt for concise information on the principal features of the Royal Arsenal at Woolwich. Great numbers visit the Arsenal every week, of whom probably many obtain all that they desire in the effect produced on the mind by the wonders they see. Many, however, wish to carry away definite trustworthy facts, and for this purpose the information furnished even by the best guides must be supplemented by printed matter. There exists a very concise popular little volume by Mr. Vincent, bearing the title "Warlike Woolwich," which we commend to our readers, especially the new edition which we hear is likely shortly to appear. We propose now, however, to give a few notes as to the present condition of the Arsenal, such as might assist a visitor at the present time, who possesses some knowledge of scientific and manufacturing questions. Two or three facts may be noted in order to enable a visitor better to understand and appreciate the character and scope of what is to be seen, and what most interesting. A Government Arsenal must differ from private factories essentially in the power to augment its forces of production suddenly in case of a declaration of war, when over 20,000 men might be employed almost immediately. It follows, then, that much more room is allowed, and much more ground covered, than in private factories. This renders it more than ever necessary to arrange the plan of the buildings in such a way as to prevent work travelling backwards and forwards in its successive stages of manufacture, and this will be found to be carried out at Woolwich more completely than usual. It may be here mentioned that a system of checking the work done by means of receipt and delivery vouchers exchanged between the different workshops, and a system of payment of men of so complete a character exists, that the Arsenal has long been regarded as a model in these respects. Piecework in one or another form is largely carried out throughout the manufacturing departments. Patterns are approved and sealed to govern the stores made in every department, which are carefully compared with them. There are altogether the following departments in the Arsenal:—Three great manufacturing establishments, namely, the gun factories, the laboratory, and the carriage department, and connected with them are the store department, the engineer department, and the chemical department. To these may be added a special machinery department; and, lastly, the offices and buildings of the Committee on Ordnance appointed to try and give a professional decision on all experimental questions.

The Arsenal is usually entered by the main gate near the Arsenal Station. Immediately opposite to the visitor coming in, is a very long, ancient bronze gun, presumably from Malta, which deserves this notice—that whereas fifteen or even ten years ago its length appeared ridiculous, it will be seen, if examined carefully, to be very nearly that which is now found to give the best results, and is adopted in new type guns.

A word or two as to the history of the Arsenal may best come in here. The Arsenal, in the form of a gun foundry, may be said to have been commenced in 1717, when the old building on the visitor's left, beyond the guard-room portico, was erected for casting guns. Bronze guns were for a long time made in the Arsenal, while iron guns were chiefly supplied by contract. It is said that the building on the right, now occupied as officers' residences, constituted the barracks of the garrison of Woolwich, while the laboratory pattern room, which we propose to take in its turn, was the cadet barracks or Royal Military Academy. We may pass over the primitive and slowly-going days of the Arsenal, and even through the Crimean war period, as affording little of scientific interest, although great strides were taken in magnitude and efficiency. The first real advance in principle was made about 1859, when Sir William Armstrong's breech-loading gun came in, its manufacture being commenced in the Royal Gun Factories on a large scale. Science, and with it complications, then ran apace, yet no ordnance of increased size was actually introduced into the service—although attempts had been made, as in the case of Mallet's monster mortar—until the Armstrong screw and stopper system of breech-loading, which was only suited to guns of medium size, gave place to muzzle-loading, when guns of 5 tons weight were rapidly succeeded by the so-called Woolwich guns of 12 tons, 18 tons, 25, 35, 38, and at length by 80 and 100-ton guns. These last were made at Elswick, but the Gun Factory authorities have long since expressed their willingness and ability to make guns of even double that weight if desired.

The order in which the various departments may best be visited depends on circumstances. The Gun Factories contain the most striking objects of interest, in the shape of gigantic forgings worked under steam hammers. As operations of this kind must be performed whenever the work is at a proper heat, it is generally wise for a visitor to repair at once to the Gun Factories and learn the time and place when large heats are to be taken out of the furnaces, or coils drawn out and wound. He can then arrange his visit to other places so as to come back to the desired point a few minutes before the specified time, which is often a little forestalled.

Supposing that all arrangements are known on entering the gate, and that time admits of it, it is perhaps best to begin by visiting the Royal Laboratory, which is the department for the manufacture of all that comes under the head of ammunition—that is to say, shell, shot, rockets, bullets, fuzes, cartridges of all kinds, and tubes, as well as torpedoes and submarine mine work. The superintendent is Colonel Lyon, R.A. The "main factory" may be conveniently visited first. It is an enormous workshop, chiefly devoted to lathe work. Overhead are 4077ft. of shafting driven by two pairs of engines at the end near the entrance. The one closest to the entrance has peculiarities which may deserve the notice of engineers. At this end of the building the course of manufacture of a bullet may be traced from the condition of molten lead to a finished bullet. The operations of squirting into lead rod and shearing, compressing, and finishing, are very pretty and complete. Much time must not be spent in the rest of the building. Objects of interest, however, may be noticed in passing, such as a Whitehead fish torpedo or a Hale rocket. The pattern-room comes next. The patterns are simply sealed and approved specimens of the finished stores, whole or in sections, made in the department. Sections of shrapnel, common, and Palliser shell should be looked at, especially observing the effect visible on the metal from chilling the head. Life-saving rockets, fuzes, and specimens of powder are conveniently seen here, also the fish torpedo and submarine mine circuit closers, &c. In the entrance hall are curious specimens of experimental projectiles, and also some chilled Palliser projectiles, which have been fired through plates of great thickness. The power of chilled iron to stand up under the blow of impact is seen in the very perfect condition of the points. The powder barrel machinery is very interesting, but seldom at work. The cap and paper factory contain some pretty machinery, such as that for making clay plugs and caps, but it may probably be necessary to pass quickly on to the shell foundry. This is entered by a beautiful pair of cast iron gates, with screens to match. The chief work of the foundry is casting common shells made of grey iron run into sand moulds, and Palliser projectiles made of mottled iron run into sand resting on massive iron moulds for the head of the projectiles, which are cast point down. The head is thus cooled by the conducting power of the metal, which chills it sufficiently rapidly to cause the projectile, when lifted out in, perhaps, twenty minutes' time, to have a black head with a body at dull red heat. The cupola furnaces are at the back. To the left is the shell factory for turning bodies, planing studs, &c. Those who are interested in iron casting should be informed that some years ago some experiments were made in this department, which indicated that the strength of a casting was greatly increased by preserving its skin intact instead of turning it off. Consequently shells have been made with sufficient accuracy to dispense with turning the exterior. The operations of pressing home studs in undercut holes, and planing them to suit any pitch of rifling, are interesting; still more so are machines employed for separating iron and brass turnings by means of magnets, which are made to pass through in continuous succession, and so pick up the iron particles which are removed by brushes into a separate tray.

The Chemical Department, under Mr. Abel, is only visited under special circumstances. There are, undoubtedly, objects of interest to any intelligent person—such as a very good specimen of a meteorite, and a shell made to mislead an unwary ship's stoker and blow up a vessel, which may possess peculiar interest just at the present time.

The Store Department, under Commissary-General Young, admits of a flying visit without interfering much with other departments. Near the Chemical Department and Shell Foundry is an archway, under one side of which is a staircase leading to the offices. Before passing through the arch, two bronze Russian guns, standing one on each side of the arch, deserve notice as specimens of hardly fought, or, at all events, hard hit pieces. One has seven or eight indentations about the muzzle due to blows of projectiles, including one shot which passed right down the bore, violently injuring it. From the top of this arch a good view of the shot-yard and surrounding places is to be had. Mallet's monster mortar, near the riverside, may be seen in the distance. The harness store may be passed through, bringing the visitor out at the commencement of the Gun Factories.

At this point would be most conveniently visited the crane on the "T" pier, capable of lifting 120 tons weight, and the system of Armstrong cranes and accumulators; and afterwards the ground on which are laid the assembled remains of guns which have burst, commonly called the "Cemetery." It will be seen that cast iron guns generally split in half longitudinally in a vertical plane from breech to a little past the trunnions, while the chase sometimes merely snaps across. One wrought iron gun which opened gradually has been taken asunder, and its various coils exhibited.

The Gun Factories come next. The superintendent is Colonel Maitland, R.A. It is desirable to see as many furnaces open and hammers at work as possible. As observed above, the whole order of visiting the Arsenal should be made subject to this. If things can be so timed, it is best to go first to the coiling furnace, and then work back through the Gun Factories, following the parts of the gun from their first commencement to their final combination in the shape of a finished piece. Before going further, however, it may be well to make a few observations on the guns themselves. Speaking generally, the pieces made in the Gun Factories are a modified kind of Armstrong gun, consisting of a steel interior barrel bored out from a solid ingot, and supported by wrought iron coils shrunk on to it. So far the guns made at Elswick and at the Royal Arsenal are similar, but there is a distinct difference in the fact that the latter are modified on Mr. Fraser's principle, which consists in using larger coils and in uniting them by welding, instead of adding them singly in succession by boring, turning, and shrinking on. In the breech the same principle is carried still further, so that in the gun factory guns the whole breech exterior, including trunnions, is welded into one mass, great longitudinal strength being thereby obtained. That the gun factories depend considerably on this, is seen in the fact that at the present moment there are competitive 43-ton breech-loading guns made at Elswick and at the Royal Arsenal, in which the gun factory gun has a larger and shorter chamber, which gives that gun a certain advantage, presuming that it is able to bear the increased longitudinal strain involved by the increased cross section. The powers of the breech thus made are illustrated in the two 38-ton Thunderer guns, which were burst by double loading, and which may be seen in sheds in different parts of the department. Very full descriptions and cuts of these will be found in The Engineer of July 18th, 1879, and April 9th, 1880. In the newest guns steel appears to be coming in in larger proportion, but in the form in which it most closely resembles wrought iron, that is to say, drawn out under a hammer into a hollow cylinder, consisting of metal whose chemical composition differs from wrought iron rather in the absence of cinder than in the presence of carbon, and whose physical structure differs mainly in the absence of a spiral fibre, but in having a closer texture. Soft steel is being worked into the coil cylinders of some guns instead of wrought iron, and the visitor will do well to ask specially for any steel work of this kind, in order to judge of its chance of success. While on this subject we may observe, by the way, that the Government experiments on the bending of steel at a blue heat, carried out at Portsmouth, have attracted close attention in some quarters, and while the startling tendency of steel to separate under these conditions has been accepted, it has also been found that iron exhibits a similar tendency. Yet there has hitherto been a belief that iron was stronger and better in all respects at about 400 deg. Fah. than at any other temperature. This subject deserves further attention. One Elswick gun, made of steel riband, noticed in The Engineer of July last, has achieved good results on trial. Light field guns are now made nearly or wholly of steel.

The furnaces of the coiling mill extend for 200ft., the flame of successive fires being drawn along by the draft of the stack at the end, so as to heat the entire length of bar. To coil the bar on to the mandril, a hole or eye made in the end of the former is pressed on to a pin on the head of the latter, and after cooling the end by a jet of water sufficiently to prevent the eye from tearing asunder when pulled, the mandril is rotated, and the coil wound on it. On the Fraser plan a second coil is often applied over the first. The mandril is then up-ended, and the coils caused to drop off. They are subsequently welded into a mass.

The Gun Factory pattern-room may be seen next. In it are patterns of guns below 25 tons weight, the interior of which may be seen to advantage by means of a light. The Mountain and smaller descriptions of field guns are also best examined here.

The guns undergo rifling in a large shop on the same side of the road, but all other operations will be found on the opposite side. Perhaps, to follow whatever may be seen, the simplest plan is to state briefly the order of the principal operations. The coils, after coming from the coiling furnace, are heated in an upright position in a reverberatory furnace, and the folds are united by striking the end at welding heat with a steam hammer. The interior is formed and joints closed by forcing a mandril into the interior, and then turning the coil horizontal and hammering it on the mandril, by which the latter is loosened and comes out. Water is thrown on to form steam and assist to remove any scale. These coiled portions when turned and bored carefully are shrunk on to the steel tube of the gun, or in the required place.

The trunnion ring is made from a solid forging consisting of slabs of iron welded together on the end of a porter bar, and eventually bored and finished. The turning and boring of the steel interior tube is a simple matter, only needing great care. The inner tube and outer coils are united in their proper order by turning the exterior of the inner tube and the interior of the coils to go round it. The general method of attaching them together is to make the inner tube stand on end in a pit, and then to heat the other one, and let it descend on to the first. In its expanded state it passes easily over it, but as it cools it grips firmly. Gas and wood are often burnt to keep certain portions from cooling too quickly It is easy to imagine the whole gun built up by such processes, which are pretty sure to be going on at any time. Turning and boring follow, and then rifling. For the latter operation to be seen it is necessary to go into the rifling shop above mentioned. When completed, the gun is sighted.

Among the guns in an incomplete state may be seen at the present time three 100-ton guns, and one of 80-tons. The 40-ton great steam hammer is the most impressive sight in the Arsenal, perhaps, when at work. The foundation has in it 630 tons of iron, besides wood and concrete. The hammer-head itself weighs 40 tons. The large forging is brought out of the furnace by means of enormous sling forceps, which carry it under the hammer. It is desirable to see the furnace opened, and operations commenced on it. If it should be necessary to wait a little, the rolling-mills hard by are worth inspection. Smaller hammers at work exhibit all that is to be seen in the case of the great hammer, though on a reduced scale. The turning and finishing of the exterior, and the sighting, as well as many earlier operations, are carried on near here, before the visitor passes on to the carriage department.

Just at this point will be seen an enormous radial steam crane in an unfinished state. This has been erected with a view of lifting weights up to 250 tons. The principle will be apparent at once; one leg pivots, the other travels on a circular railway round it, and in this way the area of ground within the rails is completely commanded. We abstain from entering into details here, intending to describe the crane, which deserves an article to itself.

On particular occasions visitors have been taken down to the proof butts, which may be done by means of a railway. The 100-ton gun mounted so as to resemble the proposed batteries at Malta and Gibraltar is now the chief feature at the proof butts, but special operations are sometimes shown there.

The carriage department may be visited last, so as to travel gradually towards the Arsenal-gate. The superintendent just appointed to this department is Colonel Close, R.A., formerly assistant in the same. The sawmills and timber-field may be seen in the distance, but hardly visited, and the wheelers' and carpenters' shops. The wheel factory is interesting—the application of the copying principle, by means of a dummy traversing the face of a model iron spoke, while the cutting-tool shapes the wood to a corresponding spoke, is good, though now old; so is the application of hydraulic power to force the various parts of the wheel together simultaneously. The main forge and scrap forge, platform shop, and main factory may follow. Here will be seen the various structures of iron and steel which now constitute our service carriages and platforms. Complete carriages may be probably seen in the mounting-ground. To a casual visitor there may merely appear complicated structures of iron, whose design he cannot grasp. A little knowledge, however, will enable any one to appreciate the great forces that have to be contended with, and the great advantage of the forms of modern carriages compared with those formerly in use. It may be noticed that the force of discharge applied against the end of the bore of the gun has to be resisted by friction or other means at the junction of carriage and platform. Hence, a couple, tending to distort the whole, is set up; the lower the carriage the less the magnitude of the couple. Hence the low brackets of modern carriages. To stop recoil, compressors of various kinds are employed; the favourite means at present, however, both in England and on the Continent, is the resistance opposed to the passage of a piston through a cylinder containing oil or water, the resistance being regulated by holes or valves. It has been a principle with the carriage department to make all carriages suitable for working by hand if necessary. The magnitude to which guns now attain, however, renders this difficult; sea service-carriages will be recognised by the employment of toothed trucks and racks everywhere. This is necessary to avoid danger from the rolling of the vessel.

The distant parts of the Arsenal are hardly ever seen, and indeed could not be visited the same day as the rest. These consist chiefly of the East Laboratory, where explosive composition work is done; the small-arm cartridge buildings, where breech-loading rifle ammunition is made up, and some buildings situated along the canal which are devoted to similar work; the cartridge case buildings, formerly termed the girls' factory, where 400 or 500 young women or girls were formerly employed; the rocket buildings, the small-arm rifle range, and cannon cartridge buildings. These are chiefly places where special precautions are necessary to avoid danger. One small building there is where the ingredients of cap composition are mixed by means of a camel's hair brush through a fine wire sieve, where if life is at all safe it is due to the observance of very strict precautions. Indeed it hardly appears as if human skill could guard against a very considerable measure of danger, as it is a question whether the majority of the men employed on this work have not been sooner or later blown up. Near the third arsenal gate is a large store where siege trains and trains of wagons are drawn up completely equipped for service. Here, also, Captain Templar's balloon work was carried on. A large field of guns extends from the coiling furnaces of the gun factory to the canal near the proof ground, and here are large stores of projectiles, &c.

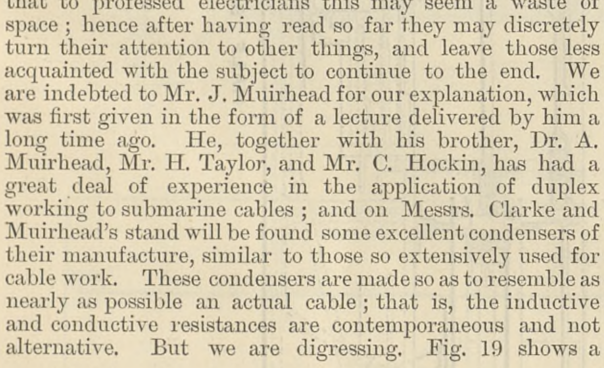
It is, of course, out of the question to do more than visit the parts of so large an establishment which present most interest. A few remarks on its general character in closing may be well. No establishment, except Essen, approaches the Woolwich Arsenal in magnitude. Her extensive Navy and her colonies necessitate England having an enormous supply of war stores, and many kinds of these are wholly made in our own arsenal. It is specially necessary to have everything of a thoroughly serviceable character, capable of resisting the effects of climate and travelling to an extent hardly demanded in the case of any other Power. This is assuredly carried out. We have our own reasons for believing that some features in the system of organisation in the arsenal are mistaken, but there cannot be two opinions as to the great merits exhibited by it as a whole.

THE PARIS ELECTRICAL EXHIBITION.

No. VI.

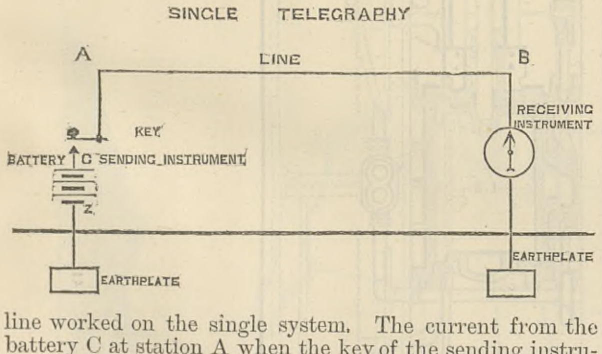
BEFORE proceeding to describe at any length the telegraphic exhibits at Paris, it will be advantageous to give a simple explanation of the duplex system without reference to special apparatus. Duplex work, however, is so common, that to professed electricians this may seem a waste of space; hence after having read so far they may discretely turn their attention to other things, and leave those less acquainted with the subject to continue to the end. We are indebted to Mr. J. Muirhead for our explanation, which was first given in the form of a lecture delivered by him a long time ago. He, together with his brother, Dr. A. Muirhead, Mr. H. Taylor, and Mr. C. Hockin, has had a great deal of experience in the application of duplex working to submarine cables; and on Messrs. Clarke and Muirhead's stand will be found some excellent condensers of their manufacture, similar to those so extensively used for cable work. These condensers are made so as to resemble as nearly as possible an actual cable; that is, the inductive and conductive resistances are contemporaneous and not alternative. But we are digressing. Fig. 19 shows a

FIG. 19.



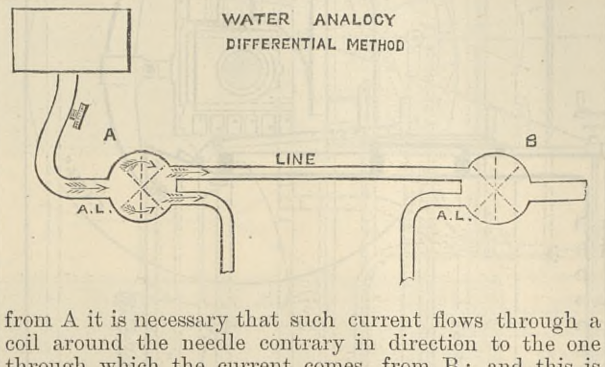
line worked on the single system. The current from the battery C at station A when the key of the sending instrument is depressed, flows along the line and through the receiving instrument at station B, giving a signal. In duplex work there is going on simultaneously sending and receiving, at both stations, with but one line wire. Let us consider the arrangement in Fig. 20. First at

FIG. 20.



Station A. The battery and key remain the same as before. The instrument in the system we are now describing, however, is wound on the differential principle; that is, instead of one coil of wire around the needle, there are two equal coils wound in opposite directions. Then a current from the battery would divide itself equally between the coils—the coils having equal resistances—and no effect would be produced upon the needle. In practice, the coils are so to speak extended, the line wire forming a part of one, and this has to be balanced by an equal resistance—artificial line—on to the other. Suppose then a current, Fig. 20, passing from the battery by N, it would divide equally around the instrument, one half passing to line, one half to earth. The part passing to line goes through one of the coils of the instrument at B, and so causes a signal. In other words, the depression of key at A does not affect the instrument at A, but does affect the instrument at B; similarly the depressing the key at B has no effect on the instrument there, but only on that at A. Suppose both stations sending at the same time. The battery power at both stations being equal, the sender at B sends a current to line equal and opposite in direction to that sent from A. These currents neutralise each other, leaving the residual half current at each station passing by the other coil to actuate the respective instruments. Thus, both working at the same instant, practically reduces each instrument to an ordinary instrument with one coil—the current through which actuates the needle. It must be remembered that ordinarily the current from B actuates the instrument at A, so that to produce the same effect at A by a current

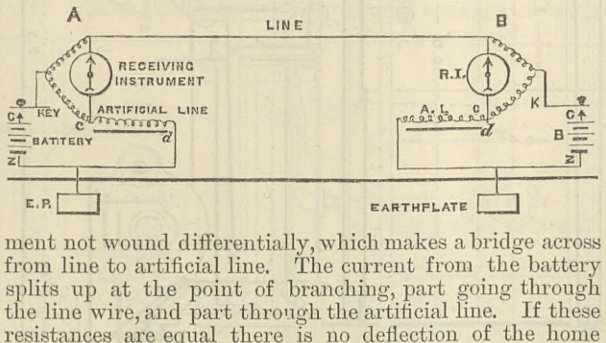
FIG. 21.



from A it is necessary that such current flows through a coil around the needle contrary in direction to the one through which the current comes from B; and this is actually the case, as will readily be seen from the above explanation. This action may, perhaps, be rendered more clear by the analogy of water. Suppose Fig. 21 represents a water-pipe constructed as shown, and that the lines in the bulbs A and B indicate wheels. When water at a certain head of pressure flows into the pipe in the direction of the arrow, if the friction of the two channels is equal, half the water will go in one direction and half in the other. The wheel or turbine at the inlet then remains at rest, but not so at the outlet; the water flowing along the upper channel will rotate the wheel at B. Now suppose water at the same head of pressure is let in at B, the current from A to B is stopped, and neither is there any current from B to A; yet both wheels rotate.

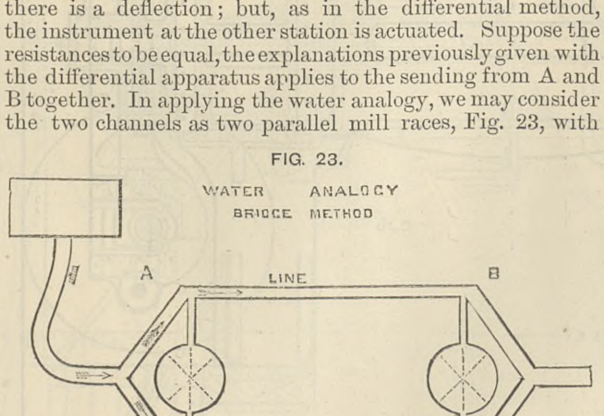
Another method of duplex working, termed the "Bridge method," is shown in Fig. 22. Here we may use an instru-

FIG. 22.



ment not wound differentially, which makes a bridge across from line to artificial line. The current from the battery splits up at the point of branching, part going through the line wire, and part through the artificial line. If these resistances are equal there is no deflection of the home instrument needle; if, on the other hand, they are unequal, there is a deflection; but, as in the differential method, the instrument at the other station is actuated. Suppose the resistances to be equal, the explanations previously given with the differential apparatus applies to the sending from A and B together. In applying the water analogy, we may consider the two channels as two parallel mill races, Fig. 23, with

FIG. 23.



a cross channel, in which is placed a mill wheel. If the loss of head and the friction of these two mill races are equal, a stream of water admitted by a sluice will divide equally, and if the cross channel joins two points at the same level, there will be no tendency for a permanent current to flow through it and turn the wheel. The channel will fill from the sides, but the wheel will not turn. If, however, the flow along the line race be stopped by shutting a sluice at B, the current would be dammed back, the surface level at A would be raised, and a current would flow through the cross channel, turning the wheel.

It is difficult at first sight for the uninitiated in telegraph work to see that the apparatus is thus simply arranged; but a little investigation will soon show that such is the case, and there will be little difficulty in slipping from duplex to quadruplex—that is when four, not two, signals are being sent on the same wire at the same time.

LOCOMOTIVES FOR THE BOMBAY, BARODA, AND CENTRAL INDIA RAILWAY.

SOME time ago tenders were sought for certain tender and tank engines for the Bombay, Baroda, and Central India Railway. The specification for both engines is the same, with the exception of the dimensions. The contracts have been awarded partly to the Vulcan Engine Company, Newton-le-Willows, and partly to Messrs. Stephenson and Co., Newcastle-on-Tyne. We illustrate the tender engine on page 220, and in a subsequent impression we shall illustrate the tank engine.

The first is an eight-wheeled (four wheels coupled) bogie passenger engine and tender of the following dimensions:—Gauge, 5ft. 6in.; diameter of cylinders, 17in.; stroke, 24in.; diameter of wheels, driving and trailing, 6ft. 1in.; diameter of wheels, bogie, 3ft. 7in.; wheel base, 20ft. 2in.; heating surface of tubes, 1019 square feet; heating surface of fire-box, 90 square feet; total, 1109 square feet; grate area, 16½ square feet; tender to contain 2000 gallons. The contract for these engines must be completed in its entirety not later than 31st March, 1882, but deliveries are to be made as follows:—Two engines and tenders by 31st January, 1882; three engines and tenders by 28th February, 1882; two engines and tenders by 31st March. The boiler is of the following dimensions:—Length, 10ft.; diameter outside (back plate), 4ft. 7½in.; thickness of plates, ½in.; thickness of tube plates, ¾in.; pitch of rivets ($\frac{13}{16}$in. diameter), 1⅞in. Fire-box casing is flush with boiler barrel; back plate is strengthened by an inside plate, and has seven longitudinal stays from the back plate to the front tube plate. Its length is 4ft. 10½in.; breadth at bottom, 4ft. 7½in.; plates, ½in.

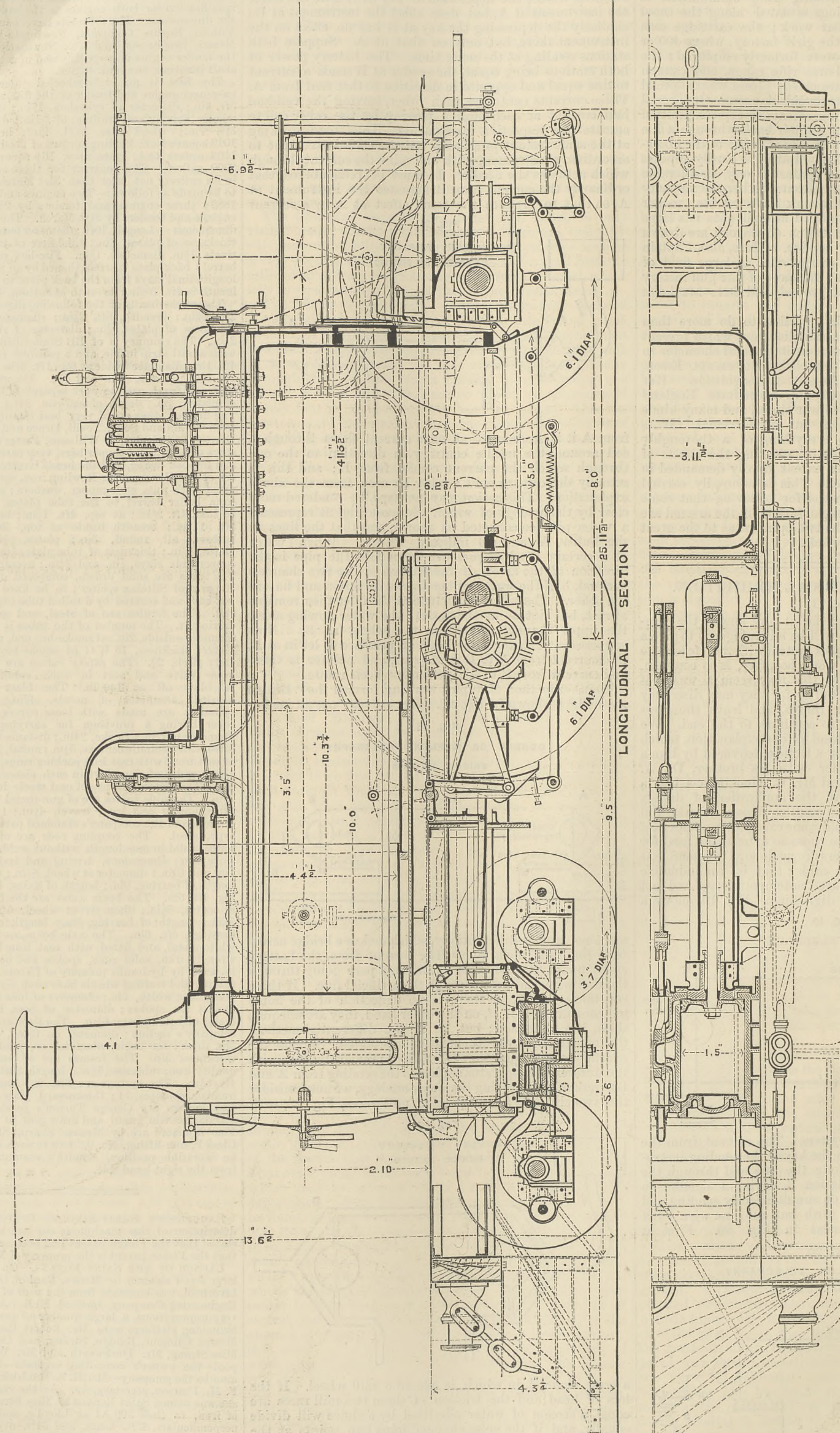
The smoke-box is of the following dimensions:—Length outside, 2ft. 8⅜in.; breadth, 5ft. 2⅞in.; diameter of doorway, 4ft. 1in.; thickness of plates, ⅜in.; diameter of rivets, ⅝in.; pitch of ribs, 2½in. The chimney is of BB Staffordshire iron; the joints made with a butt strip inside, and a polished copper top. Its length is 4ft. 1in.; diameter inside at top, 1ft. 3⅜in.; diameter inside bottom, 1ft. 5⅞in.; plates, $\frac{3}{16}$in. and ¼in. The ash-pan is made with doors back and front, each to work separately from foot-plate; thickness of plates, ⅝in.; depth of ash-pan, 1ft.; width of ditto, 4ft. ½in. The fire-box stays are of very best quality copper, to be obtained from Vivian and Sons, Nevill, Druce and Co., Pontifex and Wood, Newton and Keetes, or Williams, Foster and Co.; plates annealed, stays of soft rolled copper bars, very carefully screwed into plates and fire-box casing, and the heads rivetted over. The crown stays are of best Lowmoor or Bowling iron, screwed into the plates, and fitted with nuts and copper washers; seven palm stays extend from boiler barrel to the tube plates. Its length inside is at bottom, 4ft. 2½in.; at top, 4ft. 1½in.; breadth inside at bottom, 3ft. 11½in.; breadth inside at top, 3ft. 10½in.; waterspan at bottom, all round, 3in.; plates, ½in.; thickness of tube plates, $\frac{13}{16}$in.; thickness of tube plate, ½in.; roof stays—iron—⅞in.; copper side stays, ⅞in. and $\frac{25}{32}$in.; average distance of stays, 4in. The tubes are solid drawn, composed of 70 parts of copper and 30 parts of Silesian spelter; to be fixed with ferules at the fire-box end, and secured by a rolled tube expander at the smoke-box end. The ferules are of steel, and go into the tubes a tight driving fit. The number of the tubes is 189; length, 10ft. 5¾in.; diameter outside, 2in.; at smoke-box end, a length of 4in. is 2⅛in. diameter; thickness, 13 W G at smoke-box, and 10 W G at fire-box end; pitch, 2¾. The safety valves are Ramsbottom's duplex, a brass valve and seat in each column, and screwed down to blow off at 140 lb. The blast pipe is of cast iron nozzled. Diameter of nozzle, 4¾in.; height, 3ft. 6in. The cylinders are made with loose covers at each end, the back cover having a provision for carrying the slide bars. Their diameter is 17in.; stroke, 24in.; distance between centres, 2ft. 8in.; ditto, valve spindle centres, 5¼in.; metal, 1in. thick. The pistons are of cast iron, with cast iron packing rings, diameter 16$\frac{31}{32}$in.; width, 4¼in.; width of rings (two in each piston) ⅞in.; thickness of rings, ½in. The piston rods are of cast steel—length, 4ft. 1in.; diameter, 2¾in. The slide valves are of gun-metal with spindle frames, well filled, and of best iron, travel, 4¾in.; 1⅛in. lap, ¼in. lead. The motion is of the company's standard pattern, Allen's straight link type, steel. The coupling rods are of the best Lowmoor iron, forged solid in one length without weld. The axles are of Yorkshire iron; dimensions, driving and trailing, diameter at centre, 7in. and 6½in.; diameter at wheel, 8½in.; diameter at bearing, 7in.; length of bearing, 9in.; length of axles, 6ft. 5¼in.; centre of bearing, 4ft. 6in. The bogie axles are the following size:—Diameter at centre, 5½in.; diameter at wheel, 6¼in.; diameter at bearing, 5¾in.; length of bearing, 8in.; length of axle, 6ft. 3in.; centre bearings, 4ft. 6in. The axle boxes are of gun-metal, lined with white metal, and fitted with cast iron keeps. The wheels are of wrought iron, solid rims, spokes and bosses. Each wheel put on its axle by hydraulic pressure of 75 tons, and then keyed. The driving and trailing wheels have each eighteen spokes, diameter of boss 16in.; width, 7in.; diameter of hole in boss, 8½in.; dimensions (bogie) ten spokes; diameter of boss, 11½in.; width, 6⅜in.; diameter of hole in boss, 6¼in. The tires are of best crucible steel to company's section; diameter on tread, 6ft. 1in.; width, 5$\frac{11}{16}$in., 3in. thick; for bogie, diameter on tread, 3ft. 7in.; width, 5$\frac{11}{16}$in.; thickness, 3in. The frames are of best Yorkshire frame plate quality iron, thickness, 1⅛in.; length, 25ft. 11½in.; between frames, 4ft. 8½in. The springs are 3ft. 6in. long; breadth of plate, 5in.; number of plates, 14; thickness, 1 plate ½in., and 13 ⅜in. thick. The buffers are George Turton's patent, buffer beams of teak, standard cattle guard and draw gear to the company's drawings. The injectors are by Messrs. Sharp, Stewart and Co., "Atlas, Class F, non-lifting, No. 9," two to each engine, and are placed in an accessible position. Smith's vacuum brake is fitted to work from the right-hand side.

SAMUELSON'S SHEAF-BINDING REAPING MACHINE.—In our description of this machine in our last impression, it was in error stated that the Fisken patent had become void. We may mention that the Fisken patent is the property of Messrs. Samuelson and Co.

LAUNCH OF THE SAINT RONANS.—On Wednesday afternoon a large screw steamer for Messrs. Rankin, Gilmour, and Company, of Liverpool, was launched from the yard of Earle's Shipbuilding and Engineering Company, Limited, Hull. Although the weather was very unpropitious, a large number of people assembled. On the launching platform were Mr. Robert Rankin, Mr. W. Strang—of Messrs. Gilmour, Rankin, Strang, and Co., of London—Mrs. and Miss Strang, Mr. Duckworth and Mr. William Esplen, of Liverpool—the owner's consulting engineer—Sir John Brown—chairman to the company—Mr. H. S. Brodrick—general manager—Mr. F. H. Pearson, secretary, &c. As the vessel glided from the ways she was named Saint Ronans by Miss Strang. The vessel is built of iron, to class 100 A1 at Lloyd's, and is 402ft. long between perpendiculars, 43ft. beam, and 34ft. depth of hold. The gross tonnage is about 4600 tons, and the dead weight cargo will be about 5000 tons. She has three iron decks, all fore and aft, the upper or awning deck being sheathed with wood, and is fitted with tanks for 800 tons water ballast. She is to have four pole masts, with the fore and main masts square rigged. The vessel is to be propelled by a compound surface-condensing engine of 500 nominal horse-power, having cylinders 42in. and 84in. diameter by 60in. stroke, and steam at 90 lb. pressure is to be supplied by three large double-ended oval steel boilers. It is anticipated these engines will develope 2400 indicated horse-power on the trial trip, and give a speed of 12 knots per hour.

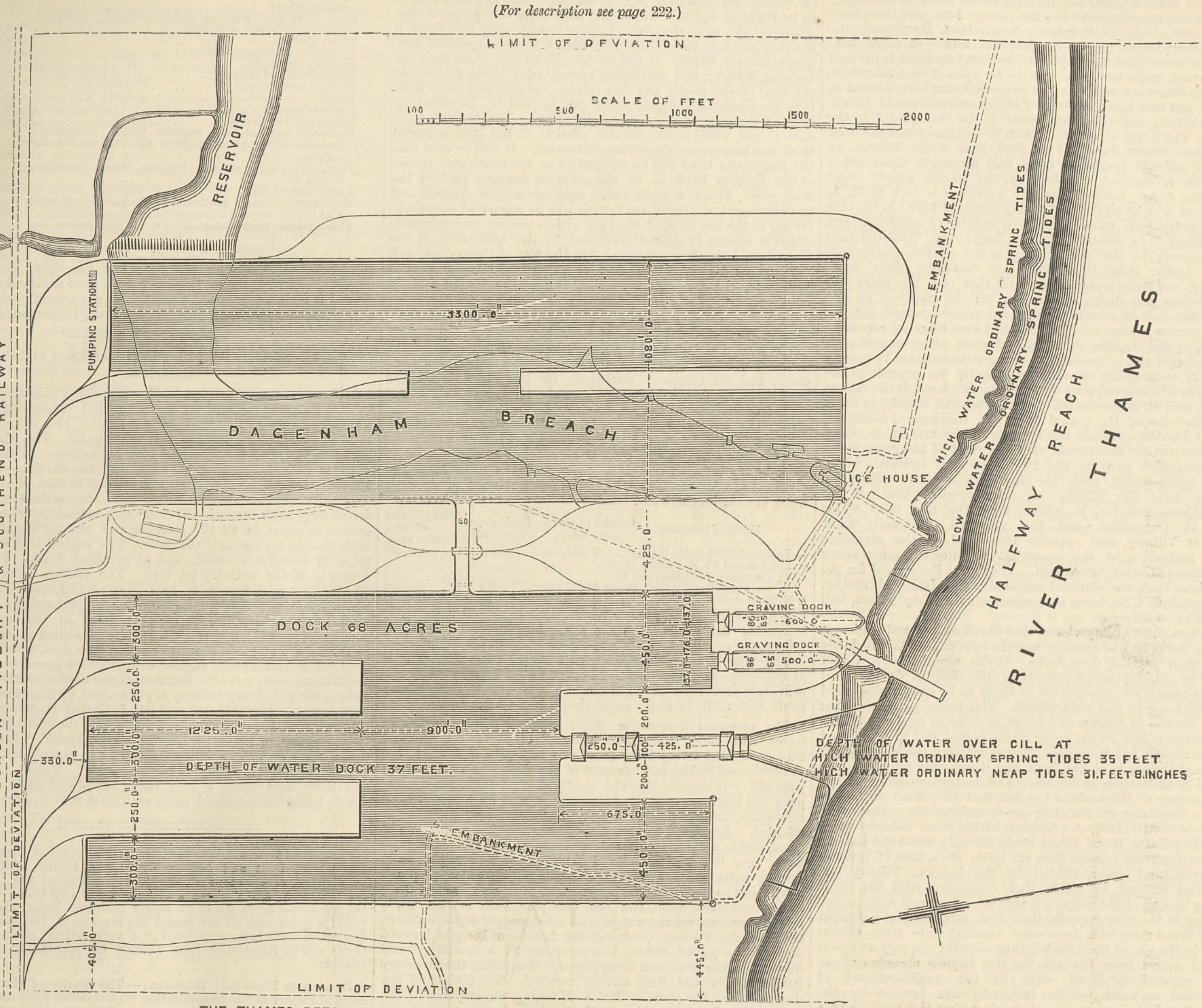
PASSENGER LOCOMOTIVE, BOMBAY, BARODA, AND CENTRAL INDIA RAILWAY.

(For description see page 219.)

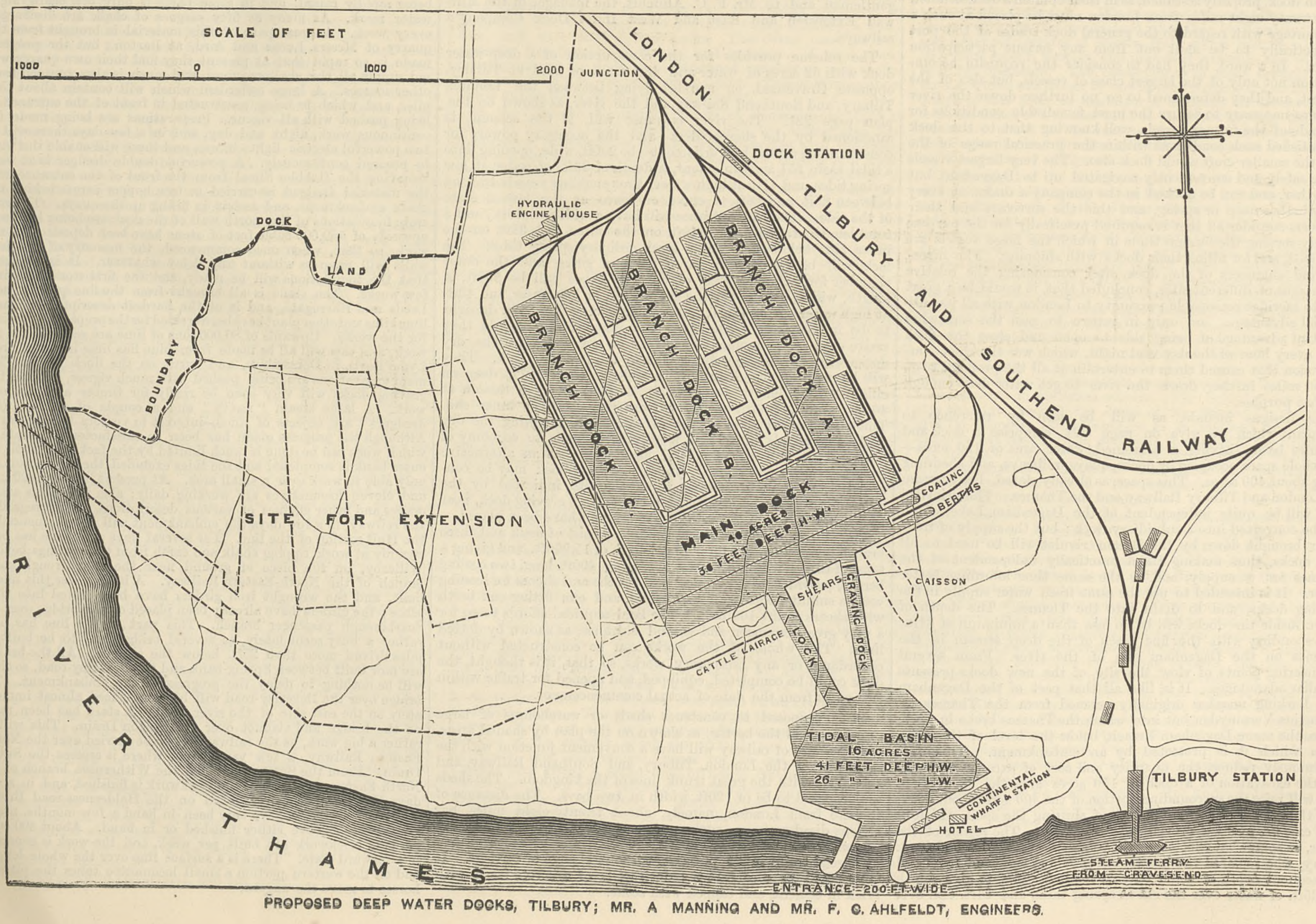


NEW DEEP WATER DOCKS ON THE THAMES.

(*For description see page 222.*)



THE THAMES DEEP WATER DOCKS, DAGENHAM; MR. JAMES ABERNETHY, PRES INST. C.E, ENGINEER



PROPOSED DEEP WATER DOCKS, TILBURY; MR. A MANNING AND MR. F. C. AHLFELDT, ENGINEERS.

NEW DEEP WATER DOCKS ON THE THAMES.

Those supposed to be competent to form an opinion, seem to think that there is practically no limit to the useful extension of the dock accommodation of English ports. Last year there were opened new docks at Holyhead, Sunderland, Hartlepool, the Royal Albert Docks in the Thames, and others of lesser area. This year there have been opened the great docks at Leith and at Liverpool, while new docks are to be opened next month at Swansea, others are making rapid progress toward completion at Milford, and now two new docks of enormous areas are, in the one case proposed, and the other about to be commenced, in the Thames. The Royal Albert Dock, with its entrance basin and dock in Galleons Reach, increased the dock area of the Thames by 81 acres, and the length of quay wall by about three miles. This dock is capable of admitting the largest vessels afloat except the Great Eastern; it has an entrance lock 800ft. in length and 80ft. in width, and with a depth of 30ft. on the sills below Trinity high water, it will be capable of admitting any vessels likely to be constructed for a long time. With the continued growth in the size of vessels for all the great trans-oceanic traffic, these large docks are becoming daily more necessary, and there seems little doubt that very few years will elapse before the docks in London will be empty of all but the smaller class of vessels. The large vessels cannot well get up the narrow reaches near London, and two tides are necessary to do it, so that besides difficulty and want of accommodation there is loss of time. Besides the changes necessitated by growth in size of ocean-going steamships, there is the growth in the London or Thames shipping trade, which has been at the rate of 336,863 tons of cargo entered and cleared, and 458,000 in cargo and ballast during the period 1875-79. Indications, moreover, are that London, or rather the Thames, will become the favourite departure port for the vessels of all or most of the great ocean liner companies, such as the Peninsular and Oriental, whose vessels, commencing with the Rome, will start from the Thames after the middle of next month. One of the chief objects, however, in constructing the new deep water docks at Dagenham, and the proposed new deep water docks at Tilbury, and opposite Gravesend, is the avoidance of the navigation of the somewhat circuitous reaches above these sites and below Greenwich. The Act of Parliament for the Dagenham Dock was obtained last session, Mr. James Abernethy, President Inst. C.E., being the engineer, assisted by Messrs. Bell and Miller, of Glasgow.

The first point of importance that the directors and engineers of these docks had to consider was the selection of the best site on the river for their deep docks. It was essential that a spot should be selected which vessels of the deepest draught and greatest length yet constructed or likely to be constructed could reach with safety and convenience. This being given, then, the nearer the site to London the better in order to render the docks of practical utility to the trade of the port. The directors and their engineers had the whole Thames between the Royal Albert Dock and the sea to choose from, and it was only after the most careful consideration of the river, and mature weighing of the requirements of the trade of London, that they fixed on Dagenham as the fittest site for their great undertaking. They were fortunate to find there, at a distance within three miles by water from the existing Royal Albert Dock, and only about one mile by road further from London than the latter dock, land of little or no agricultural value, skirted by the London, Tilbury and Southend Railway, by which their connection with the whole railway system of the country is secured, a deep and wide stretch of water in the river opposite their dock entrance, and a straight line of broad river with deep water running right from Greenhithe to the site of their docks, thus securing an easy and convenient access from the sea for the largest steamers afloat. They rejected proffered sites in the neighbourhood of Gravesend as much too far removed from London for the object they had in view, viz., that of serving the purpose of a London dock, properly so-called, as in their opinion a dock situated some twenty-eight miles from London must be placed at such a disadvantage with regard to the general dock trades of the port as practically to be shut out from any serious participation therein. In a word, they had to consider the requisite accommodation not only of the largest class of vessels, but also of the smallest, and they determined to go no further down the river than was necessary to secure the most favourable conditions for the trade of the former vessels, well knowing that to the dock that satisfied such conditions within the practical range of the City, the smaller craft would flock also. The very largest vessels can be safely and conveniently navigated up to Dagenham, but no further, and can be docked in the company's docks at every tide, whether neap or spring, and this the directors and their engineers consider all that is required practically for the purpose of duly serving the foreign trade in which the large vessels are employed, and for filling their docks with shipping. The directors and engineers of the dock, after considering the relative advantages of different sites, concluded that it would be a great loss, to sacrifice reasonable proximity to London with all its substantial advantages, and only in return to gain the somewhat doubtful advantage of being able to open and close the dock gates every hour of the day and night, which was the chief consideration that caused them to entertain at all the proposal to go several miles further down the river to get water deep enough for that purpose.

The designs include, as will be seen by reference to the plan which we give on page 221, comprise a dock and entrance basin, having a combined water area of 150 acres—the whole space occupied by docks, quays, railways, and shedding being about 400 acres. This space, as already stated, lies between the London and Tilbury Railway and the Thames. The principal dock will be quite independent of the Dagenham Lake, which will be converted into a subsidiary dock; but the supply of fresh water brought down by the Bream rivulet will be used to fill both docks, thus making them practically independent of the Thames for a supply, and at the same time affording better water. It is intended to use the same fresh water supply in the graving docks, and to drain into the Thames. The depth of water inside the docks will be no less than a minimum of 34ft., corresponding with the fine reach of the deep stream in the Thames on the Dagenham side of the river. From several engineering points of view the site of the new docks presents peculiar advantages. It is, like all that part of the Dagenham and Barking marshes originally rescued from the Thames by Cornelius Vermuyden but into which the Thames broke in 1707, hence the name Dagenham Breach, below the level of the river, from which it is protected by an embankment. This fact enormously reduces the quantity and cost of excavation work, for the excavation of a dock of 150 acres area the spoil taken out will raise the surrounding portion of the 400 acres about 12ft., and thus much of the usual cost of shifting the spoil, which in this case lies over the gravel, will be obviated. The *régime* of the river, as somewhat affected by the works of Vermuyden and Capt. Perry, who repaired the breach, has provided sufficient scour and consequent depth of water outside the lock gates, to give depth of 35ft. of water over the sill at spring tides, and 31ft. 8in. over the sill at neap tides, which will enable the dock to accommodate vessels of the size of the City of Rome, while there are no dangerous reaches below Dagenham to prevent the easy approach of vessels six hundred feet in length. The entrance lock is to be 100ft. in width, a width Mr. Abernethy has adopted elsewhere, so that even the Great Eastern could enter this dock if the entrance lock were made 10ft. longer than at present proposed, namely, 675ft. It will be seen from our plan that the London, Tilbury, and Southend railway runs along parallel to the ends of the docks, and that sidings and junction lines from it to the whole of the quay walls can be laid as indicated by lines on the plan, so as to secure direct and easy transport from dock to rail, while on the eastern portion of the land acquired there is a large space for railway extension. It will be seen that the Dagenham Lake will be stopped off at the north-east corner of the Eastern Dock by an embankment forming part of the dock wall. There a fresh water reservoir will be formed, and the outer part of Dagenham Breach will be converted into dock. Owing to the low level of the land within the old embankment, which is shown in dotted lines, and to the utilisation of the Dagenham Lake, it is estimated that the cost of these docks will not exceed about £1,500,000, or as the total water area is 150 acres, £10,000 per acre, which, it need hardly be said, is extremely low.

In fact, the Dagenham Docks will be by far the cheapest docks connected with the Port of London. A contract has been framed to carry out the designs of Mr. Abernethy, and the estimated cost of £1,500,000 includes equipment, railway sidings, immense sheds, and all necessary machinery for the most economical working of the traffic. To judge of the relative economy of the cost of construction, we have only to refer to the following table giving the respective amounts of the dock water area of the different dock companies of the Port of London at which the general dock trade of the port is now being carried on, for it must be remembered that in a given port the measure of the dividend-earning capacity of a dock is the relation of its dock water area to its share and bonded capital:

Name of company.	Capital in shares and bonds.	Dock water area in acres.	Cost per acre of dock water area.
1. East and West India Docks ..	£3,352,052	106	£31,623
2. London and St. Katharine Dock Company, including the Victoria and Royal Albert Docks	£9,727,875	211	£46,103
3. Millwall docks	£1,326,550	36	£36,850

Whereas the Thames Deep Water Company's 150 acres, even supposing the whole of their share and bonded capital of £2,000,000 expended, would not exceed £13,333 per acre.

The area of the quays is 350 acres, while the length of the quays is 28,200ft., or 5·34 miles. Two graving docks are provided, each 86ft. in width at top and 65ft. at bottom, and 600ft. and 500ft. in width respectively.

The proposed deep-water steam dock at Tilbury is not in water area much more than one-third that of the docks at Dagenham, but a very large quay area and quay wall length are to be secured by the arrangement of the dock plan as shown on page 221. It appears that the East and West India Dock Company has been for some time seeking a scheme for extending the steamship accommodation which the South West India Dock afforded. According to a circular addressed to the proprietors of these docks, a scheme for enlargement was contemplated two years ago, but was abandoned as being on too small a scale. Subsequently another scheme was considered, which proposed converting part of the company's premises known as the Osier Bed into a deep dock, and had this plan been carried out, it might have enabled the company to retain its supremacy. Now, however, the Tilbury Dock scheme has been brought forward and is to be placed before the company at a special general meeting on the 30th inst. for approval. Meanwhile the necessary land has, it is said, been already secured. The designs of the dock are from the plans of Mr. A. Manning, the engineer to the company, and the inception of the entire scheme is due to that gentleman and to Mr. F. C. Ahlfeldt, the manager of the Millwall Extension and East and West India Dock Company's railways.

The scheme provides for the construction of a deep-water dock with 62 acres of water and 480 acres of land at Tilbury, opposite Gravesend, on marshes lying between the London, Tilbury, and Southend Railway and the river, as shown on the plan page 221. The river entrance will, if the scheme is sanctioned by the shareholders—and the necessary powers for construction granted by Parliament—be 200ft. wide, opening into a tidal basin 15½ acres in extent, a depth of 26ft. of water at low spring tides, and 41ft. at high water; thus enabling vessels drawing between 25ft. and 26ft. to enter or leave at the lowest state of the tide. The lock entrance will have a width of 80ft., and a total length of 700ft., with 40ft. on the outer and 35ft. on the inner sills below high water level ordinary spring tides. The lock will be fitted with three pairs of gates, and the outer chamber for locking vessels of ordinary types will be 500ft. in length, with a depth over the sill of 25ft. at low water, and 40ft. at high water spring tides; thus enabling vessels of 25ft. draught to be immediately passed into the inner docks; should they arrive even at the moment of low water spring tides. The dry docks will be in line nearly parallel to the entrance lock. They will be made in one length, 80ft. wide at invert, 27ft. deep on cills, the total length being 825ft., divided off by a caisson at 400ft., 450ft., 500ft., or 550ft. from the north or inner end. This arrangement gives special advantages in adapting the dry docks for vessels of various lengths, and tends to economy of construction and working, and also serves as an alternative entrance to the wet docks. Another graving dock may be constructed, if thought necessary, at the site indicated by the dotted lines near the word caisson of the large graving dock, near the centre of which the word caisson should have been placed.

The Inner docks, or docks proper, consist of main and three branch docks, having a total quay length of 15,000ft., and giving a total of thirty working berths, averaging 400ft. long, two coaling berths, provided with elevated coal staiths and shoots for loading vessels simultaneously on both sides, and one fitting-out berth with shears to lift 100 tons. The land acquired affords room for a very great extension and second entrance, as shown by dotted lines. The whole of the works can be constructed without cofferdams, or any temporary works, so that, it is thought, the dock could be completed, equipped, and opened for traffic within two years from the date of actual commencement.

It is proposed to construct sheds or warehouses of large capacity at all the berths, as shown on the plan by shaded areas, and the lines of railway will have a convenient junction with the main line of the London, Tilbury, and Southend Railway, and therefrom with the great trunk lines of the kingdom. The sheds are proposed to be of 120ft. width in two bays. The distance of the site from London, namely, about twenty-eight miles, has serious disadvantages, such as loss of time and extra costs, but passenger communication with the City will be accomplished by special trains in 35 minutes, without change of carriage. It is proposed to construct the dock walls of concrete faced with brick in cement, and capped with stone.

The following is the estimated cost of construction and equipment of the proposed Tilbury Dock:—

	£
Purchase of land and buildings on site, including compensation, less value of buildings, works, and machinery at coal wharf	75,000
Dock work and graving docks, including railways, paving quays, &c., complete	629,400
50 ton shears	4,500
Machinery at coaling berths	8,000
Fencing and roads	12,000
Warehouses and sheds	126,000
Ditto at steam wharf	3,000
Hotel	8,000
Cattle lairage	10,000
Offices and residences	12,000
Hydraulic engine-house, engines, mains, machinery, and cranes on quays, electric lighting, and water supply	90,600
Tugs, dredgers, pontoons, hoppers, boats, moorings, buoys, &c.	37,500
Legal charges, &c.	10,000
Engineering and all preliminary charges, except legal and land surveyor's expenses	45,000
Plant and gear for working rolling stock, locomotives, &c.	25,000
Total	1,096,000

It is believed that when twenty out of the thirty berths are regularly occupied, the earnings will pay a good dividend on this sum. It is, however, a much larger cost per acre of water than that given above as the estimated cost of the Dagenham docks.

MESSRS. GALLOWAY AND SON'S COMPOUND ENGINE.

The motive power for the woollen machinery exhibited at the Crystal Palace is supplied by the compound condensing engine which we illustrate this week on page 224. The cylinders are 14in. and 24in. diameter and 2ft. 6in. stroke. The air pump bucket is 8in., and the fly-wheel 15ft. in diameter. The driving strap is 80ft. long and 18in. wide, and the driving pulley is 6ft. in diameter. The engine is placed in one of the bays on the north side of the Palace near the orchestra, and it drives a lay shaft beneath the floor and behind it, from which motion is given to all the spinning and carding machinery by belts coming up through the floor. The engine is a very fine piece of work, substantial, and of excellent finish. The condenser is of the ordinary jet type. The variable expansion is effected by a modification of Pius Fink's well-known link gear, which is, in our opinion, far superior in performance on the whole to the modified Corliss gear fitted to the somewhat similar engine exhibited at Paris by Messrs. Galloway and Sons in 1878. We may add that in this view the firm coincide, and they sell at least twenty engines with the Fink gear for one with the instantaneous cut off. Such an engine as that at the Crystal Palace, with Galloway boilers, is guaranteed by the makers not to use more than 2 lb. of coal per indicated horse-power per hour, the boiler pressure being 70 lb., and the speed 70 revolutions, or 350ft. of piston per minute. The Crystal Palace engine under these conditions indicates 125-horse power, but several similar engines are doing 140-horse power. Messrs. Galloway and Sons have made a very large number of these engines, which, being self-contained, meet with great favour abroad.

Peninsular and Oriental Steam Navigation Company.—The Clyde, built and engined by Messrs. Denny Brothers, of Dumbarton, of 4100 tons register, went her trial on the Clyde on the 13th inst., and attained a mean speed of 15·9 knots—equal to 18¼ miles—per hour, the horse power indicated being 4900. This vessel is fitted with all the recent improvements, the saloon and decorative work being completed in a very artistic manner. The Clyde will be despatched from London to Calcutta on the 11th October.

Hull and Barnsley Railway.—The works of the dock in course of construction in connection with this line have made great progress during the last few weeks. The river embankment is being rapidly raised, and in some parts is only 5ft. below high-water mark. As many as fifty cargoes of chalk are discharged every week. A great part of this material is brought from the quarry of Messrs. Lucas and Aird, at Barton; but the progress made is so rapid that at present they find their own quarry will not supply all the chalk required, and much is also obtained from other sources. A large cofferdam which will contain about 1500 piles, and which is being constructed in front of the entrance, is being pushed with all vigour. Preparations are being made for continuous work, night and day, and in a few days there will be two powerful electric lights in use, and these will enable the work to proceed continuously. A powerful double dredger is at work removing the Hebbles Shoal from the front of the entrance, and the material dredged is carried in iron hopper barges behind the chalk embankment, and assists in filling up the quays. The concrete foundations of the north wall of the dock are being laid, and upwards of 150,000 cubic feet of stone have been deposited on the work, so that, when once commenced, the masonry of the dock walls will progress without any delay whatever. It is expected that the foundations will be ready, and the first stone laid, in a few weeks. The stone is all brought from the fine quarries near Leeds and Harrogate, and is of the hardest description. Large lime kilns and other plant have been erected for the preparation of lime for the works. Upwards of 80,000 tons of lime are required for the work, and this will all be made from blue lias lime imported from Lyme Regis, in Dorsetshire, and burnt on the dock works. The main excavations are being pushed with much vigour, and the two graving docks will very soon be ready for timber and masonry work. A large steam "navvy" and a couple of steam "grab dredgers" are objects of much interest to visitors to the works. Although the progress made has been so satisfactory, the rate at which work can be done is much limited by the fact that, until the outer bank is completed and the tides excluded, the contractors are only able to work over a small area. At present, nearly 1000 men and eleven locomotives are working daily; also numerous steam cranes and other engines of various descriptions. With regard to the railway, in a few days the embankment will be commenced of the Hull section of the line. For several days an engine has been steadily at work tipping chalk and earth from the cuttings beyond Willerby, on the piece of ground near the Scarborough goods branch of the North-Eastern Railway. A bridge over this line is built, and the wrought iron girders have been lifted into their place; the girders have already been placed on the bridge over the Scarborough passenger branch. This part of the line has been rather a busy scene lately, as several bridges had to be built on piles driven more than 25ft. below the surface. All the bridges are now built between Spring-bank and the Beverley-road, so there will be nothing to delay the progress of the embankment. The bridge over the Beverley-road will be commenced almost immediately on the east side of the river Hull. A start has been made on the bridge and viaduct over the Sutton Drain. This will be rather a big work, as the railway has to be carried over the North-Eastern Railway, a few yards from where it crosses the Sutton Drain. From the Sutton Drain to the Withernsea branch of the North-Eastern Railway all the brickwork is finished, and in a few days the girders will be lifted on the Holderness-road Bridge. Although the works have only been in hand a few months, nearly all the bridges are either finished or in hand. About 400 cubic yards of brickwork are built per week, and the work is generally in a forward state. There is a surface line over the whole length, and on the western portion a small locomotive takes the place of horses to move the wagons.

RAILWAY MATTERS.

THE Queensland Government are not expected to introduce the transcontinental Bill this session.

AN agitation has been commenced at Albany, New South Wales, for connecting Germantown with the Great Southern Railway by a tramway.

THE completion is announced from Krasnovodsk of the trans-Caspian military railway, the rails having been laid as far as the terminal point at Kyzil-Arvat.

THE Monument of London will, it is expected, be taken down during the construction of the Tower Hill underground station. It will be re-erected on the same site.

THE Canada Pacific Railway is completed as far as Sandy Hills, a point about 100 miles west of Winnipeg. It is expected that another ninety miles will be completed before the end of the year.

A CONTEMPORARY understands that negotiations are said to be pending for the transfer of the Louth and Lincoln Railway to the Great Northern Railway Company.

THE report of the Commissioners for Railways of New South Wales, just published, shows that the expenditure in 1880 was £13,042,041, and the earnings £513,219. Eight hundred and forty-nine miles of line were open for traffic, and 347 in course of construction.

THE St. Gothard Railway has been officially inspected by an international commission, the members of which were conveyed through the great tunnel without change of carriage or going any part of the way on foot. A great deal of work remains to be done, and it is not probable that the mails will begin to be regularly carried through the tunnel on wheels before January next.

IN the beginning of 1846, when a Broadway elevated railroad was discussed and illustrated in the *Scientific American*, it probably seemed extravagant to suggest hourly trains on a single track in Broadway. The most active imagination would scarcely have gone beyond the prediction that half-hourly trains on a double track would be required. Now what do we see? Four double lines, comprising 32 miles of elevated track, on which are run an aggregate of over 3000 daily trains, as shown by the inventory of property of the Manhattan Elevated Railway Company. It appears that to carry on this enormous traffic 200 locomotives and 600 cars are used, which stop at 161 stations, the force employed being about 3000 men, whose pay exceeds 5500dols. per day. As many as 274,000 persons have been carried in a single day, who paid about 18,000 dols. for the accommodation.

WRITING upon the proposed railway between Barnsley and Bradford by way of Dewsbury and the Spen Valley, the *Leeds Mercury* says that it is attracting much attention in Dewsbury and elsewhere, and recalls the fact that during the time the Railway King was in the zenith of his power a company was brought out for the formation of a railway to run between that town and Barnsley. Like many other undertakings brought out at the same period, it collapsed, to the very great regret of the townspeople, who saw in it an opportunity of getting to the Barnsley coal-fields for the fuel required for households and manufactures. Since then the population of the heavy woollen district has doubled, and the Spen Valley, which then had a comparatively small number of inhabitants, is now thickly peopled, and contains numerous large woollen mills and other important works.

A NEW arrangement for the protection of points and prevention of accidents on single lines and branches to quarries, &c., has been brought out by Mr. William Pinkerton, engineer to the Ballymena and Larne Railway. It consists of an iron box or cover for the point levers, with a lock so arranged that the door can only be opened by the train staff of the section; a bar or horn attached to the levers prevents the door being shut while the points are open, and as the staff cannot be removed from the lock until the door is shut, it is impossible for the train to leave until the points are closed. The sidings being opened only for trains carrying staff, no signals are required, thus effecting a considerable saving, not only in the original cost of signals, connections, and extra levers, but in lighting, maintenance, and wages, and the arrangement is so simple that the duties of pointsman can be performed by any of the train officials. It is impossible to tamper with the lock, as a strong iron escutcheon instantly closes over the orifice on the withdrawal of the staff, and cannot again be raised until the staff is brought into requisition.

THE aggregate yearly additions of rolling stock to the lines of the United Kingdom in the years 1871-80 averaged 369 engines, 1146 passenger trains, and 12,303 goods trains, vehicles. The rate of increase in the period for the three classes of stock stood, relatively—engines 33 per cent. increase, carriages 34 per cent., and wagons 40 per cent. Allowing for traders' wagons taken over, it would appear that the additions in each class have been in about the same ratio. Relative to mileage of line open the supply is now very much larger than ten years ago. The number of engines is now equal to 0·75 per mile of line, as against ·65 in 1871. This being the average, some lines must be very short of locomotives, for on the best equipped lines there are from 1·5 to 2·5 locomotives per mile of line worked. Passenger carriages 2·28 as against 1·99; and goods wagons 21·84 as against 18·27. Relative to traffic receipts, these, and the supply of rolling stock, can only be compared upon the average earnings of the three classes of rolling stock. It would thus appear that in 1871 each engine earned £4679, and in 1880 £4704. In 1871 each passenger train vehicle earned £675, and in 1880, £666. In 1871 each wagon earned £94, and in 1880 £91. The *Railway News* points out that as each engine now earns more than ten years ago, the supply numerically cannot have been unduly increased.

THE report of Major-General Hutchinson to the Board of Trade on the collision which occurred on the 6th July, at Wymondham North Junction, on the Ely and Norwich section of the Great Eastern Railway—when the engine of the 11.57 a.m. down passenger train from Wymondham to Tivetshall, while crossing from the down main line to the down line of the Forncett branch at Wymondham North Junction, was struck by an unattached engine and tender running on an experimental trip on the up main line from Norwich to Wymondham—concludes:—"This collision was caused by the want of proper care on the part of the driver of the unattached engine. This engine—No. 247—was fitted with an automatic Westinghouse brake, actuating blocks on the four hind wheels of the engine and the six wheels of the tender, as well as with the ordinary tender hand-brake. Two previous stops had been made, at Trowse and Hethersett, when the air-brake had acted well. On approaching Wymondham North Junction, the driver found both the up distant and up home signal against him; but apparently expecting the home signal to be taken off, he approached it at so high a speed that, notwithstanding the powerful brake at his disposal, he overran the home signal by a distance of thirty-five yards, and came into collision with the engine of the passenger train on the junction crossing. As the air-brake had been acting properly at Hethersett a few minutes previously, and was found to be in working order after the collision, I cannot credit the driver's statement that he applied it half-way between the junction distant and home signals, or some 500 yards from the point of collision, and that, finding it was not taking effect, he himself applied the tender hand-brake. It would rather appear that the air-brake was applied when the engine was close to the home signal, and that the driver, seeing that there was then not time enough for it to take effect, endeavoured to supplement its action by himself applying the tender brake. This collision shows that the working of the block system, as carried out at Wymondham North Junction, where the rules permit that 'line clear' may be given to Hethersett for a train due to stop at Wymondham when the main up line is being crossed, is not sufficient to insure the safety of the public. This requires that the up line should neither be crossed nor fouled when 'line clear' has once been given to Hethersett, and *vice versâ*."

NOTES AND MEMORANDA.

DURING the Congress of Electricians at Paris, Mr. Graves caused some surprise by asserting that in our telegraph practice we are able to transmit messages at the rate of 200 words a minute. M. Cochery, Minister of Posts and Telegraphs, after addressing the meeting, offered to place a long line at Mr. Graves disposal, to give every facility, and to pay all expenses necessary to have a fair trial of it. On our longest line, namely, from London to Aberdeen, an average rate of 180 or 200 words a minute is attained.

IN an account of a continuation of experiments on the fluid density of certain metals, by Prof. W. Chandler Roberts, F.R.S., and T. Wrightson, C.E., the following table containing the results obtained is given:—

	Sp. gr. solid.	Sp. gr. liquid.	Percentage of change in volume.
Bismuth	9·82	10·055	Decrease 2·3
Copper	8·8	8·217	Increase 7·1
Lead	11·4	10·37	„ 9·93
Tin	7·5	7·025	„ 6·76
Zinc	7·2	6·48	„ 11·10
Silver	10·57	9·51	„ 11·2
Iron	6·95	6·88	„ 1·02

THE seventh report of the British Association Committee on Underground Water Supply shows that the Permian, Triassic, and Jurassic formations of England and Wales are capable of absorbing from 5in. to 10in. of annual rainfall, giving a daily average yield of from 200,000 to 400,000 gallons per square mile per day. The area occupied by these formations is, in round numbers, Permian and Trias, 8600 square miles, and Oolites, 6600 square miles, capable of yielding 1720 million and 1320 million gallons respectively, at the lowest rate of absorption, or, united, a supply for 100 million people, at 30 gallons a head. At the meeting Mr. De Rance described the water-bearing condition of the Yorkshire area, and stated that the investigation would now be extended to all the porous rocks of South Britain.

THE increased number of telegrams from year to year shows that the reduction of tariff and the greater facilities offered for using the telegraph are much appreciated by the Parisians. In 1880 the number of messages, for the capital only, was 969,177, yielding 579,857f. In these figures are included the pneumatic telegrams, the adoption of which system took place in 1879; and of these 334,445 were telegram cards, which produced 120,483f., and 123,800 closed messages, which yielded 68,914f. The reduced tariff for the pneumatic system came into force June 1st, 1880, telegram cards being reduced from 50c. to 30c., and other messages from 75c. to 50c., and the increase in the number of messages was very marked. Between June and December, 1879, there were 100,335 telegram cards and 25,657 closed messages, whereas in the same period last year there were 234,907 cards and 95,713 messages—an increase of 134 and 259 per cent. respectively.

A REMARKABLE wood, known as "mountain mahogany," is said to grow in Nevada. A local paper thus describes it:—The trees do not grow large. A tree with a trunk a foot in diameter is much above the average. When dry, the wood is about as hard as box-wood, and being of very fine grain might, no doubt, be used for the same purposes. It is of a rich red colour and very heavy. When well seasoned it would be a fine material for the wood carver. In the early days it was used for making boxes for shafting, and in a few instances for shoes and dies in a quartz battery. Used as a fuel it creates an intense heat. It burns with a blaze as long as wood would last, and is then found—almost unchanged in form—converted to a charcoal that lasts about twice as long as ordinary wood. For fuel a cord of it always brings the same price as a ton of coal. The only objection to it is that it creates such an intense heat as to burn out stoves more rapidly than any kind of coal, however bad.

IN an article on japanning, the *Scientific American* says the work to be japanned is cleansed, dried, and warned. If of wood or other porous material it is given while warm several coats of wood-filler, or whiting mixed up with a rather thin glue size, and is, when this is hardened, rubbed down smooth with pumice stone. It is then ready for the japan grounds. Wood and similar substances require a much lower degree of heat and usually a longer exposure in the oven than metals, and a higher temperature may be employed where the japan is dark than when light. The japanner's oven is usually a room or large box of sheet metal, heated by stove drums and flues, so that the temperature indicated by a thermometer or pyrometer can be readily regulated by dampers. The ovens are also provided with a chimney, a small door, and wire shelves and hooks. The ovens must be kept perfectly free from dust, smoke, and moisture. A good, cheap priming varnish for work to be japanned consists of pale shellac 2 oz., pale rosin 2 oz., rectified spirit 1 pint. Two or three coats of this is put on the work in a warm dry room.

IN the "Second Geological Survey of Pennsylvania, 1875 to 1879," by John F. Carll (Harrisburg, 1880), the author says that the origin of petroleum is in some way connected with the vastly abundant accumulations of paleozoic sea-weeds, the marks of which are so infinitely numerous in the rocks, and with the infinitude of coralloid sea animals, the skeletons of which make up a large part of the limestone formations which lie several thousand feet below the Venango oil-sand group, scarcely admits of dispute; but the exact process of its manufacture, of its transfer, and of its storage in the gravel beds, is utterly unknown. That it ascended rather than descended into them, seems indicated by the fact that the lowest sand holds oil when those above do not, and that upper sands hold oil where they extend beyond or overhang the lower. The chemieal theory, so called, which looks upon petroleum as condensed from gas, the gas having been previously distilled from the great black shale formations—Marcellus and Genesee—must face the objection that such a process, if chemically possible, which is doubtful, ought to have distributed the oil everywhere, and permanently blackened and turned into bituminous shales the entire thickness of this part of the earth-crust for several thousand feet. It fails to explain the petroleum obtainable from the cannel coals and from the roof shales of bituminous coal-beds; and it fails also to explain the entire absence of petroleum from immense areas of not only shales, but sand and gravel rocks, equally underlain by the Marcellus and Genesee formations.

IN a paper on "The Water Power of Niagara," read before the recent Bankers' Convention at Saratoga, Mr. Delano described a remarkable development of power at Niagara Falls, soon to be completed. There will be three turbines, 4ft. in diameter, with 80ft. of head fed by a tube 7ft. in diameter, each turbine giving 1000-horse power, with the whole power of the great lakes and the Niagara river to re-enforce them. Some of the rivers which have been dammed for the benefit of mankind, and the force which they furnish reduced to the standard of horse-power, are given as follows by the *Scientific American*:—The Passaic, at Paterson, N.J., 1000-horse power; the Merrimac, at Lowell, 10,000; the Mohawk, at Cohoes, 14,000; the Connecticut, at Hadley, 17,000; the Androscoggin, at Lewiston, 11,000; the Housatonic, at Canaan Falls, 3000; the Mississippi, at the Falls of St. Anthony, 15,000; the Oswego, at Oswego, 4000. The sum total of these is 75,000-horse power. But this is used over again on an average not less than three times. This would show a larger total of 225,000-horse power. There are also very many smaller streams in all the hill sections of the country which are utilised, and may furnish an aggregate, used and unused, equal to the last-named total of 225,000, thus giving a grand total of nearly 500,000-horse power, distributed over a wide extent of country, and supplying in their way the wants of 50,000,000 of people. From data furnished by the United States Lake Survey Bureau in 1875, it appears that the average flow of the river above the falls is 10,000,000 cubic feet per minute. Converting this into horse-power under a head of 200ft., we have a grand aggregate of 3,000,000-horse power—a mighty force that would supply the economic wants of 200,000,000 people.

MISCELLANEA.

A NEW lighthouse at Barrenjuly, New South Wales, has been completed at a cost of £16,000, and an official visit made by the Marine Board. The light is 370ft. above high-water mark.

SIR W. HART DYKE has recovered £7950 compensation from the Darenth Valley Main Sewerage Board for damage done to his estate, Lullingstone Castle, by the sewer laid through it. He claimed £20,000.

THE Plumbago Crucible Company, Battersea, has been awarded the gold medal at the Frankfort Exhibition of German patented manufactures, for its "Salamander" crucibles, which do not absorb moisture or require annealing.

THE Iron Wire, Wire Rope, and Fencing Company, of Westminster, has just completed the execution of a very large contract for over 254 miles of wire fencing for the South Australian Government to the value of nearly £15,500.

MINING engineers have just discovered at the Earl of Dudley's Broad Lanes Colliery a bed of coal, 14 yards thick in some parts, and at a distance of but six yards from the surface. The coal is said to be of good quality, and will be got out by means of open works, shafts being dispensed with.

THE following is the result of a trial of 1000 lb. of coal from the Indwe, South Africa, as given by the *Colonies and India*:—Gas, per ton of coal, 6011 cubic feet; illuminating power, 13 sperm candles; specific gravity (air 1000), 600; coke per ton of coal, 1455 lb.; ash in coke, per cwt., 26.

AS people in the country villages have been unable to see the apertures in the wall letter-boxes after dark, Mr. Rea, the Post-office Surveyor for the Eastern Counties district, has caused the apertures of the wall boxes in the neighbourhood of Cambridge to be encircled with luminous paint. The experiment has been successful.

IT seems that the great landslip at Elm was more due to slate quarrying than to rain. The quarrymen had gradually taken out the props, as it were, and let the mountain down. Just as in other cases, the disintegration of the foot rocks of mountains has taken away the retaining wall in the natural work of levelling the surface of the globe. The number of deaths at Elm seems to be nearer 115 than 200, most of whom had just left church; but besides these there are some workmen and visitors who may considerably increase the number.

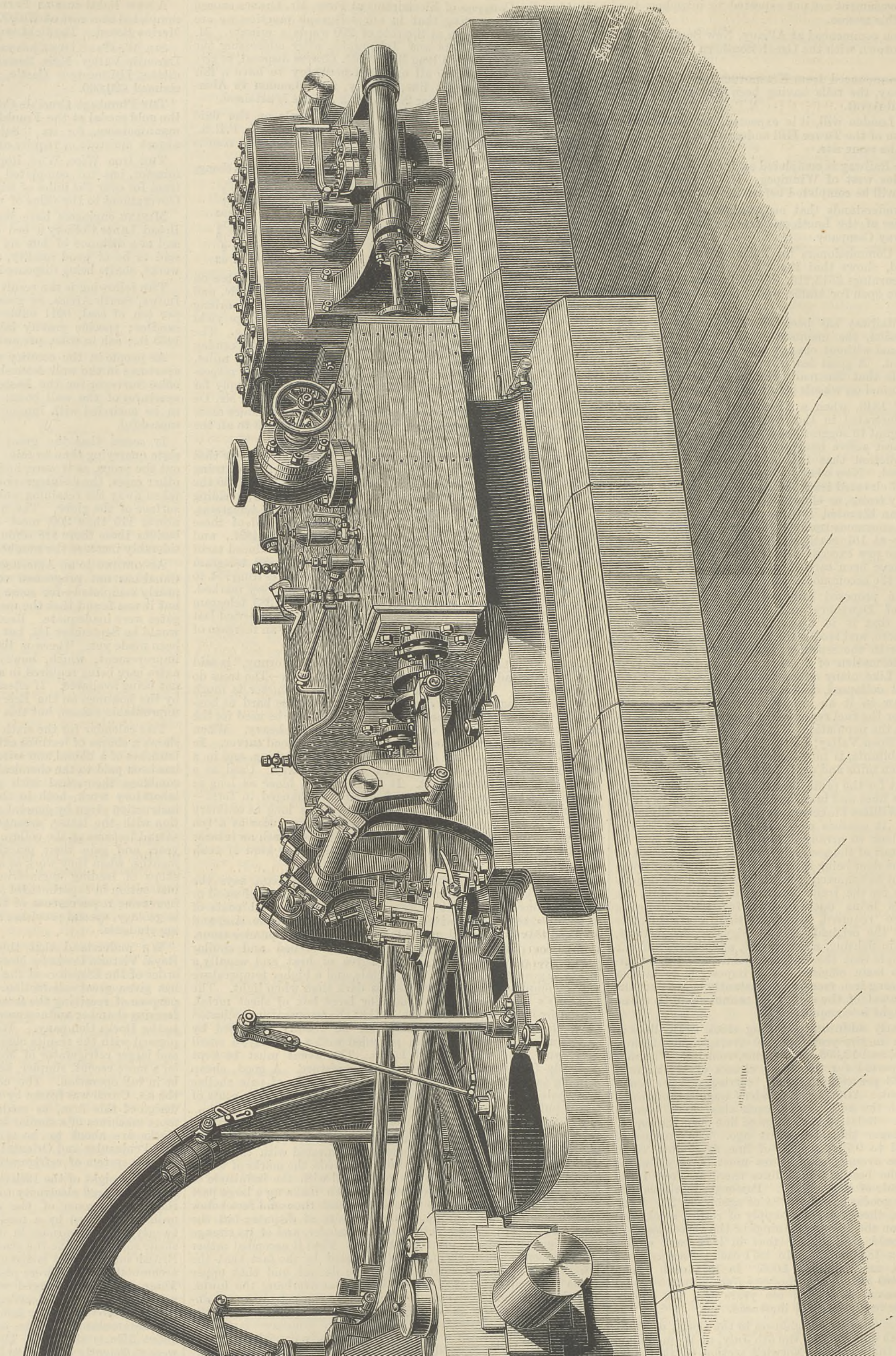
ACCORDING to an American contemporary, the enlarged Welland Canal has not progressed very rapidly towards opening—though nearly completed—for some time. It was to be opened July 1st, but it was found that the mechanism designed for working the lock gates were inadequate. Recently it was expected that the opening would be September 1st, but no announcement of such opening has been made yet. There is time enough yet this year to test the improvement, which, however, will not be complete this year, extra care being required in some of the locks, and the full depth not being available. If effective at all, it will probably be felt first by the boatmen on the Erie Canal, who have been having a very unprofitable season, but this week have secured a little advance.

THE calendar for the sixth session of University College, Bristol, shows a course of lectures extending over all or nearly all the chief branches of a liberal and scientific education, but special attention has been paid to the chemical and engineering departments. Each combines theoretical with practical instruction. In the former laboratory work, both in the day and evening, supplements the instruction given by general and technical lectures; and in connection with the latter, arrangements are made by which students attend lectures at the college during the six winter months of the year, and gain their practical experience during the summer months, when they work as articled pupils in the offices and workshops of leading engineering firms of the neighbourhood. The instruction in experimental physics is kept abreast of the rapidly-increasing requirements of the age, and in this subject, as well as in geology, special provision is made for the wants of the engineering students.

WE understand that the refrigerator recently erected at the Royal Victoria Docks by Messrs. J. and E. Hall, of Dartford, to the order of the Directors of the London and St. Katharine Docks Co., has given great satisfaction. The refrigerator was erected for the purpose of receiving the frozen meat imported from Australia, the freezing chamber and accessories having been fitted up by the engineer to the Docks Company. We hear that the company are so well pleased with the results obtained, that they have ordered a second and larger refrigerator of Messrs. Hall, which will be constructed on a more recent, simpler, and improved principle, and will shortly be in full operation. The consignment of meat brought over by the s.s. Cuzco was frozen by one of the refrigerators of the original design of this firm, as made for a company in Australia. Two more machines of a similar kind to those about to be used at the Docks are about to be sent to the same Australian company. The Peninsular and Oriental and other companies are also adopting this system of refrigeration.

ON the night of the 16th September inst. the first practical application of stored electricity to the lighting of interiors took place in the smoking-room of the Junior Carlton Club. The room is ordinarily lighted by a modified form of sun-burner, with about twenty-five gas-burners in it. Beneath this has been suspended a shade somewhat like the shade of an umbrella, and in this fifteen British incandescent lamps are placed. The electricity came from accumulators which were placed in the basement of the building. These had been charged with electricity at the Hindon-street works of the British Electric Light Company, and had been brought into the club only a few hours before the lighting-up took place. The accumulators used are on the Faure principle, and each cell is about 15in. × 9in. × 4in. The number of cells was forty. They were sufficiently charged to last about six hours. This application practically shows the immediate scope there is for the recent great advancements in electrical science. The light has been brought into the club through the desire of Mr. Martin, the secretary, to give the members the advantages to be obtained from the use of incandescent lamps. The work is in the hands of the British Electric Light Company, whose engineer, Mr. Radcliffe Ward, personally superintended the work. The result was universally pronounced most successful. The accumulators were charged by Gramme dynamo-electric machines.

THE Glasgow College of Science and Arts has just commenced its first session. It existed for some fifty-eight years under the name of "The Glasgow Mechanics' Institute," but the directors having reconstituted and remodelled the whole character of the institution, and secured, by the aid of Hutchesons' Hospital, a new staff of lecturers and teachers, obtained the necessary authority for a change of name last spring. From a perusal of the syllabus we observe that great efforts are being made to facilitate the education of young engineers, shipbuilders, architects, chemists, builders, and young apprentices generally belonging to and engaged in our various industries by evening lectures, and also for those who have not yet entered upon an apprenticeship by day classes in mathematics, mechanics, drawing, and other subjects, the fees being in all cases very low. At the last science and art examination the students did remarkably well, a large percentage of all those who went forward having passed, and many taken prizes, and one obtaining second-class honours, and first in the elementary stage, with silver medal at the City and Guilds of London technical examination in telegraph engineering. Mr. William Raitt, M.A., B.Sc., is lecturer for mathematics. Mr. Andrew Jamieson, C.E., is the principal, and he takes several of the subjects. The courses are pretty fully set forth in the syllabus, which may be obtained on application to the secretary. The engineering syllabus is sent for 2d., electricity, &c., 1d., mathematics 1d.; complete 4d. The college promises to afford that technical education which has been found wanting in Glasgow as much as in some of the great engineering centres south of the Clyde.



COMPOUND CONDENSING ENGINE, CRYSTAL PALACE WOOL EXHIBITION.

MESSRS W AND J. GALLOWAY AND SONS, MANCHESTER, ENGINEERS.

(*For description see page 222.*)

FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Madame BOYVEAU, *Rue de la Banque.*
BERLIN.—ASHER and Co., 5, *Unter den Linden.*
VIENNA.—Messrs. GEROLD and Co., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—THE WILLMER and ROGERS NEWS COMPANY, 31, *Beekman-Street.*

TO CORRESPONDENTS.

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a* 1d. *postage stamp, in order that answers received by us may be forwarded to their destination. No notice will be taken of communications which do not comply with these instructions.*

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

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.*

SCALES.—*Engine divided scales are the best.*

W. R.—*If you like to send a drawing, we will give you an opinion as to the merits of your invention.*

A POOR SCHOLAR.—*What you propose is well known. It is neither more nor less than the archimedean screw pump, probably invented* 2000 *years ago, if not more.*

I. S. H.—*The treatise on "Mechanics," published by Lockwood in Weale's Series, will do you very well to begin with. Afterwards read Tyndall's "Heat as a Mode of Motion."*

J. A. W. (Folkestone).—*You can easily arrive at the truth by asking your patent agent to send you the certificate of allowance, which he cannot do if he has not applied for the patent.*

A READER OF THE ENGINEER FOR SEVEN YEARS.—*You will find full information concerning the examinations to be passed by engineers in the mercantile marine in* THE ENGINEER *for* 13*th and* 20*th Sept. and* 25*th Oct.,* 1878.

A. B. C.—(1) *For information about safety valves and boilers consult Molesworth's "Pocket-book of Engineering Formulæ."* (2) *Your second question does not admit of being answered, as it supplies no data on which to found an opinion. The probability is that the change in gearing would effect a small saving in fuel by permitting the steam to be used more expansively than it now is. The book you name is for sale, and is published at the office of the "Colliery Guardian."*

TEMPERING STEEL.

(*To the Editor of The Engineer.*)

SIR,—If "Steel" will coat his articles with soft soap before he puts them in the fire they will come out clean. G. M.

Bolton, September 20th.

NOISELESS ROAD WHEELS.

(*To the Editor of The Engineer.*)

SIR,—We have to make a street sweeping machine of either wood or iron, and want information as to what materials would be best to make the wheels of so as to cause as little noise as possible as it is drawn along the street. Can any of your correspondents help us? F. G. R.

Sunderland, September.

A PROBLEM IN HEAT.

(*To the Editor of The Engineer.*)

SIR,—If I turn a current of steam at the pressure proper to 300 deg.—say 70 lb.—into a current of air heated to 300 deg., what will take place? Will the mixture have a higher or lower temperature than 300 deg.? The steam cannot exist in a saturated condition at more than 212 deg., for its pressure will fall to 15 lb. on the square inch—that of air into which it is blown—but the air being at 300 deg. will re-heat the steam. The total quantity of heat will be greater in the mixture than before, yet it appears that the temperature will be less. Is this true? The steam in expanding down to atmospheric pressure without doing work will be slightly superheated—that is to say, its temperature will be about 218 deg. instead of 212 deg. To give definite form to my question, let me ask if 1 lb. of saturated steam at 300 deg. be mixed with 1 lb. of air at 14·7 lb. pressure and 300 deg., what will be the resulting sensible temperature, the mixture being supposed to have a pressure of 14·7 lb.? QUERIST.

London, September 20th.

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BIRTH.

On the 16th inst., at St. Bees, Cumberland, the wife of ROBERT WHITE, M. Inst. C.E., of a son.

DEATH.

On the 8th April last, at Tufnell Park-road, Holloway, Capt. THOMAS HENRY HOCKLY, C.E., late of Chunar, Bengal, aged 63. Indian papers, please copy.

THE ENGINEER.

SEPTEMBER 23, 1881.

MARINE ENGINE PROPORTIONS.

IN our last impression we examined Mr. Marshall's table of dimensions of various marine engines appended to his paper on "The Progress and Development of the Marine Engine," read at Newcastle before the Institution of Mechanical Engineers. Although we have dealt with Mr. Marshall's figures at some length, we have by no means said all that can be said on the subject. We reproduce the table on page 229, and our readers can pursue to its last limit the enquiry we have begun. If they do they will find occupation for a considerable period. We have shown that the ratio which the heating surface of a boiler bears to the power developed is a matter of very little consequence, so long as certain somewhat indefinite limits are not over-passed. We shall now proceed to show that the extent of condensing surface supplied is of not more importance. We shall not go through all the cases stated by Mr. Marshall; a few will suffice. Let us take, for example, engine No. 3 in the table. The indicated power of this engine is 1200 horses; the condensing surface, 2400 square feet, that is to say, 2 square feet per horse-power; consumption of fuel, 1·63 lb. per horse per hour. Turning to No. 14 we find 7427 square feet of condensing surface, and 2000 indicated horse-power. Here there are 3·71ft. of cooling surface per indicated horse-power; but this augmented area does not appear to do any good, as the engine consumes 1·8 lb. of coal. For No. 6 we have 4865ft. of condenser, and 2677 indicated horse-power. This is 1·8 square feet per horse-power; consumption of fuel, 1·67 lb. per indicated horse-power per hour. This is less than half the condensing surface allowed in the case of No. 14. Engines No. 26 have 1600ft. of condenser, and indicate 600-horse power; consumption of fuel, 1·945 lb. per horse-power per hour; area of condensing surface 2·66 square feet. This engine works at 90 lb., and is in every way better off for surface of all kinds than many of its fellows in the table which beat it in economy. Leaving condensing surface we turn to grate area, a very important factor, one would imagine, in marine engine economy; but here again we find the same diversity of practice, the area varying between 1 square foot for 6·43 indicated horse-power, and 1 square foot for 9·8 indicated horse-power. The area of the grate appears within these limits to exercise no influence whatever on economy.

It will be seen from the table that the engines with most heating have not usually the most condensing surface. It will be found instructive to compare two ships of the same power—the one with maximum, and the other with minimum surfaces. Let us suppose the power in both cases to be the same, 2000 indicated horses, and the engines shall also be the same, namely, two cylinder compound, 54in. and 97in. diameter, by 5ft. stroke, and 480ft. of piston speed per minute. The engine with maximum surface we shall call A. That with minimum surface, B. For each indicated horse-power A will have 3·71 square feet of condenser, 5·52 square feet of heating surface, and ·15 square feet of grate surface. The consumption of fuel will be about 1·8 lb. per indicated horse-power per hour. B will have 1·8 square feet of condensing surface, 2·88 feet of heating surface, and about ·11 square feet of grate surface per horse-power, consumption of fuel probably 1·67 lb. per horse per hour; but we shall call it 1·8 lb. Putting these figures into totals, we have for A 7427 square feet of condensing surface; B will have 3600 square feet. Of heating surface, A will have 11,040 square feet, while B will have only 5760 square feet. The grate surface in A will be 300 square feet; in B it will be 220 square feet. There is no reason to doubt that B will work just as well and as economically as A; but it requires no mathematician to prove that the first cost and weight of B ought not to exceed two-thirds of those of A. The shipowner who uses engines A consequently does so at a dead loss to himself, as compared with the shipowner who uses engines B; and even though it could be shown that the machinery B was overworked as compared with A, it would still be found very difficult to prove that this overwork would transfer any portion of the saving effected to the wrong side of the ledger. Without going to extremes, however, it is impossible to consult Mr. Marshall's figures without seeing that the first cost and weight of large numbers of marine engines must be much greater than they need be; but no attempt is made, or can be made, to prove that the heaviest machinery is in the long run the best. The table supplies ample evidence, we regret to say, that marine engines and boilers are proportioned by rule of thumb; and this, while the design, workmanship, and material may be all that is excellent. Putting the matter in another point of view, it may be said that some ships do not work up to their full power. Take, for example, No. 14 in the table; these engines ought to indicate about 4000-H.P. They have sufficient heating and condensing surface for this. But not to push matters to extremes, it is easy to see that they could indicate 3000-H.P. without the smallest trouble. Why are they not made to do this? Obviously the vessel is a passenger steamer, and we suppose that her owners would rather like to run her at a good speed; the engines now make only 48 revolutions per minute, corresponding to 480ft. of piston. If the pistons made 560ft. per minute, as do those of No. 27, then the revolutions would rise to 56 per minute, and we may assume that the power could be increased in the same ratio—that is to say, it would be augmented from 2000-horse to 2333-horse power—a considerable gain; but there is no good reason why the engines should not make 65 revolutions per minute, when the power would be 2700, and with a very little less expansion, and a rise in the pressure from 70 lb. to 75 lb., it would be easy to get the power up to 3000-horses. But the speed at which an engine will run depends, other things being equal, on the dimensions of the screw propeller; and there is every reason to believe that in this case the screw is too large for the engines, and has locked them up. The pitch is not given, but the diameter is 18ft. 10½in. It may be, of course, that the owners of the ship do not wish their engines to work up to more than 2000-horse power. If this be the case, then it is obvious that they have put machinery very nearly twice as large as necessary into the ship. If we extend our inquiry to the proportions which propellers bear to the engines, we shall find yet more remarkable evidence of the operation of the rule-of-thumb system. Unfortunately Mr. Marshall has given only the diameters of the propellers. It has long been considered that the propeller should bear some definite ratio to the engine intended to drive it, but practice seems to run in the opposite direction. Thus, we have engines indicating 270-horse power driving a propeller 12ft. 6in. diameter at 72 revolutions per minute, while engines of 1230-horse power have to be content with a 13ft. propeller, revolving at 75·7 revolutions per minute Engines No. 20 indicate 1135-horse power and make 55 revolutions, driving a screw no less than 20ft. 9in. in diameter. These engines are speeded too slowly for the heating surface, but not for the condensing surface. It would be impossible to push this part of the inquiry further because the data available are too limited, but we have no doubt that further examination would prove that confusion worse confounded exists among engine-builders, shipowners, and naval architects alike as to what are the proper proportions for any given screw. This ought not to be the case. It is true that there is wide latitude for diversity of practice in shaping screws, but the pitch and diameter ought in all cases to bear a definite relation to the engines, and the power exerted by these last ought to bear in like manner a relation to the ship.

Mr. Marshall has done admirable service in bringing facts before the world. It is almost impossible, indeed, to over-rate the value of such a table as that which we publish. It ought to open the eyes of the whole community of shipowners, and serve to convince them that it is quite possible they may be wasting year after year very large sums of money. The questions we have raised do not refer to the size or weights of engines. We have purposely left this question untouched. Heating and condensing surface are, however, two most important factors in determining the weight and cost of the propelling machinery of a ship, and as we have seen, these may be and are frequently provided in excess. Chaotic as marine engine practice appears to be, there are, however, certain limits defined, which determine the proportions of engines, boilers, and condensers; and it is possible to deduce from Mr. Marshall's paper a very few simple rules which will give results as good as can perhaps be got. The heating surface per indicated horse-power should be 3 square feet; the condensing surface, 2 square feet; the grate surface, ·11 square foot per horse-power, or 1 square foot of grate for 27 superficial feet of heating surface. The weight of fuel burned per foot of grate per hour will be about 16 lb., which can be easily done with a fair draught. If Mr. Marshall's figures are right—and we have no reason to doubt their accuracy—our readers may rest assured that the proportions we have named are those which will give on the whole the best results, and that any machinery which departs widely from them is either very much too big or very much too small for its duties.

STEAM ON COMMON ROADS.

THE publication of the Report of the Select Committee of the House of Lords on the Highway Acts again draws attention, amongst other things, to the question of employing of steam on common roads, and to the bar to all progress in such steam locomotion which the existing inefficient Act for the regulation of the use of road locomotives presents. With respect to road locomotives and traction engines, the Committee report that:—"Locomotives for purely agricultural purposes rarely exceed 10 tons, and from the great service which they render to a class of the community who contribute very largely to the rates which maintain the roads, any undue restriction on their use is much to be deprecated; but while the roads should be maintained in a condition sufficient for such traffic, there seems no reason why they should be kept in such a state as to bear, without adequate compensation from the user, locomotives employed for purposes of drawing heavy loads for mineral or other traffic. Where the roads cannot be used by locomotives without danger to the public or obstruction to the traffic in narrow roads, the highway authority should have power to prohibit their passing, but in this case there should be an appeal to the county authority." To these recommendations, except, perhaps, the last paragraph, no one interested can take any objection. The Committee recognise the "great service" which these engines render to "a class of the community," by which it may be supposed they refer to agriculturists; but they have not particularised what they consider to be "undue restrictions" on the employment of road locomotives. The existing Act of 1878 is notoriously obstructive, and is besides this inefficient, and in some respects defeats its own object, as for instance in the clause which makes it compulsory that an attendant "shall precede by at least twenty yards the locomotive on foot, and shall, in case of need, assist horses, and carriages drawn by horses passing the same," for not only is it difficult for one approaching the engine from the rear to attract the attention and get the assistance of this man, but the man is at some other distance than twenty yards ahead immediately he commences to give such assistance, and in case of accident the man is liable to be summoned for not being ahead of the engine. When the report of the Select Committee on locomotive engines on roads was published in 1873, it was found that the necessity for some relaxation of the restrictions to the use of road locomotives was fully recognised; and it was hoped that the recommendations of the Committee would be embodied in an early Act on the subject. It was not, however, until 1878 that another Act was passed, and this gave very little relief, and almost wholly disregarded the recommendation of the Select Committee of 1873. Committee after committee has been appointed to consider this question, and three Acts have been passed in seventeen years to regulate the use of road locomotives, two of these having been passed in order to remove vexatious restrictions; and yet the law as it stands can only be looked upon as one standing in the way of all progress in the improvement of locomotives for facilitating transport and intercommunication between towns and country places not served by railway. The road locomotive has become more than ever necessary to agriculturists. It was seen that they would be so necessary in 1861, for the Act of that year commences, "whereas the use of locomotives is likely to become common on turnpike and other roads;" yet that same Act hampered their use so much as to confine it to special instead of general purposes. The fact that the value of these engines to a most important section of the community is again recognised is, therefore, no guarantee that anything will be done to facilitate their employment; and that the report of the Commission of 1880-1 shows that it considers that "any undue restriction on their use is much to be deprecated," affords very little hope of relief. The members of a committee appointed to inquire into the subject have so much evidence of the obstructive nature of the existing law and of the possible value and already extensive employment of road locomotives under great disadvantages forced upon them, that they cannot help recommending that the law should be altered. Unfortunately the labours of the Committee are almost wholly thrown away, for their recommendations are disregarded by those who vote in the House of Commons on the subject without sufficiently considering it. The existing law is framed so as to regulate steam on common roads as represented by the heavy traction engine. By far the larger number of engines now in use are of the agricultural locomotive or light traction engine type. The free use of these engines would not only be a great source of economy and convenience to the farmer and market gardener, but to the consumers of the produce of farms and gardens. At present, however, they are used only under such restrictions that the economical advantages derivable are only partially gained, while increased rapidity of transport for all vegetable and fruit produce, which would be of very great advantage to all, is almost entirely lost.

The undue restrictions in the use of road locomotives are chiefly those on (1) speed; (2) on the hours during which engines may be used; (3) on the liability of owners for the repair of roads; (4) as to blowing off steam; (5) as to consuming smoke; (6) as to walking attendant. In proof of the necessity for greater speed it is only necessary to point out the rapidly growing demand in country districts for increased railway accommodation in order to place the producer in easy communication with the consumer, and to afford country people the means of communication with market towns, to which they can only go at present by the slow periodical carrier, if they do not possess horses or donkeys of their own, and there are many who possess neither, but who have often urgent need of means of transport. The carrier's cart is too slow, and too restricted in carrying power, and the farmer and market gardener find horses and wagons very costly and slow as compared with the cost of transport by road locomotives when they can employ them. Extension of the maximum speed would be followed by the use of lighter locomotives, which could serve the requirements for passenger and goods traffic for numerous villages and homesteads miles away from railways, and which the census returns for 1881 show are gradually being depopulated. This depopulation is most where communication with towns is most difficult, thus showing the necessity for improving the means of communication if villages and hamlets are not to be deserted. Light locomotives drawing two vehicles would offer many advantages to agricultural communities which could not be given by railway extensions, for these, though running regularly between certain villages and towns, could depart from the main or usual road, when necessary, to take up a load. They could go to the load, and save farmers and others taking the load to the train. These trains should be allowed to run at from eight to ten miles per hour; but the engines should be in the hands of intelligent and qualified men, instead of the wholly ignorant men that often have charge of the traction engine to-day. (2) All restriction as to the hours during which road locomotives in the country may be used should be removed, for the dangers which belong to working such engines at night are greater than any in the day time, as is shown by the Board of Trade report on the Maidstone accident in December last. Engine drivers, even with good lamps, have a good deal of groping about in the dark to do. Their attention is taken off the proper care of their engine with respect to steam pressure, water, oiling, &c., by the necessity for watching the road, and keeping a look out for passing horses and vehicles, which, again, they cannot either see or help as in the daytime. The men are, moreover, not under that supervision which they would be under in the day. (3) Agricultural locomotives or light engines, such as would be used for communication between villages and towns for the purposes here referred to, should be free from special taxation for road maintenance, and in this respect the recommendation of the Committee, as above quoted, ought to be observed in any amendment or new Act which may be passed for the better regulation of, or it might almost be said, permission to use, steam on common roads. As to 4 and 5, we may quote the evidence given in the Maidstone inquiry already referred to, but must first mention the clause as to steam blowing off, which is—"Nor shall the steam be allowed to attain a pressure such as to exceed the limit fixed by the safety valve, so that no steam shall blow off when the locomotive is upon the road." Everyone, but the members of Parliament who voted in this Bill for this Act, must see that this virtually assumes an impossibility, and makes safety valves unnecessary. It imposes a fine of £10 for blowing off a little steam, but says nothing against using excessive pressure. A locomotive meets with an obstruction, or has to stop to let some uneducated horse pass. Steam, nearly up to safety valve pressure, continues to rise. The result is, as stated in the evidence above referred to, as follows: "The law leads to danger. The men do not know what to do under the circumstances. If they blow off the steam they are fined; if they keep it in they run the risk of explosion, and if they let it down they are fined for making a smoke." We must admit that under ordinary circumstances a really intelligent driver and stoker can work an engine so as not to need to blow off or to make much smoke, and the Act only requires that the smoke shall be consumed as far as practicable. But exceptional cases arise; generation of steam cannot be sufficiently checked to prevent its blowing off without tampering with the safety valves, and magistrates and constables have ideas upon smoke-consuming very different from what either would hold after driving an engine under the various restrictions for a week. Except, however, in cases of gross carelessness or unusual delays, not much smoke should be emitted, and then, in the spirit of the Act, no magistrate could order a fine. As to the blowing-off of steam, it seems to be the opinion of many—and we believe fines are still inflicted under bye-laws since the passing of the Act of 1878—that this clause of the 1865 Act is still in force. The Act of 1878, however, repealed it as far as concerns England, but it is still within the power of parochial authorities to make bye-laws for the regulation of the use of road locomotives, which may include one against blowing off steam. This, however, is plainly contrary to the spirit of the Act, which repealed the section, part of which is quoted above. With respect to 6, we have already mentioned some objections, and need only to remark that the Bill, which was spoiled into the 1878 Act, required only that an attendant should accompany road locomotives on foot.

The recommendations of the 1880 Committee will meet with a different fate from that of those which have preceded them if they are carried into effect; but the real necessity for reducing agricultural expenses and facilitating communication in rural districts may induce the Government to do something towards the removal of restrictions which impose great loss and inconvenience on a class already heavily pressed.

THE COAST TRADE OF INDIA.

In our issue of April 23rd for last year we offered some remarks under the above heading in comment on the old-world methods still employed in India for the carriage of the interportal traffic between the numerous coast towns of India and Ceylon. These, situated over a range of several thousand miles of littoral line, are populous and important, and considering the development the internal trade of both the countries named has received by the construction of railways, it seems extraordinary that so little has been done to secure the services of coasting steamers to supersede the old and clumsily-built vessels which have been used from time immemorial. These, from their construction, are utterly unable to make any way at all unless the wind happens to be dead astern. A native "dhoney," when attempting to beat to windward, makes as much leeway as forward progress, being worse in this respect than a Dutch galliot without her lee boards. It is with satisfaction that we learn that a start has been made to remove the reproach as to such backwardness, and it is with still greater satisfaction that we are informed that that start has been initiated by a native merchant, who, by doing so, has set an example to his countrymen which it is to be hoped will be widely followed. Mr. Tambayah is a native of Jaffna, in the island of Ceylon, and is recognised as one of the wealthiest and most public-spirited men in the colony. Whether or not the remarks we offered in our previous article on this subject came under his notice we are uninformed, but it is certain that he is acting up to the spirit of them. An agent despatched by him is now in England to obtain the pioneer vessel of a line of small steamers which Mr. Tambayah designs to run between Colombo, the maritime capital of Ceylon, Tuticorin, on the coast of India, and Jaffna, the extreme northern port of Ceylon. Should this first essay prove successful, Mr. Tambayah contemplates the addition of other steamers of the same class, and as there is at the present time a large traffic with immigrant coolies proceeding from India to Ceylon, and returning thence after a few months of labour on its coffee estates, there is a nucleus of paying traffic which the facilities likely to be offered by Mr. Tambayah's steamers is pretty certain to largely develope.

The *Ceylon Observer* has recently been discussing the desirability of improving the existing harbour—it hardly, we believe, deserves to be so called—at the proposed terminal port of call, Jaffna. A large trade exists thence to the southern Indian ports; and with improved harbour accommodation and regular steam communication, this may be expected to greatly increase. We understand the contract for the first vessel—which is to be called the Lady Longden, out of compliment to the wife of the present Governor of Ceylon—has been taken by Messrs. Forrest, of Limehouse. She will be but a small boat, being about 220 tons builder's measurement, and having engines of 40-horse power nominal. Although only a little craft, every care is being taken by the superintending engineer charged with her construction to ensure her being fitted in the highest degree for the work she will have to perform. Steel exclusively will be used in her construction, the light draught essential to her passage over the shallow bars so common at the entrance of Indian harbours and rivers necessitating such material being used, even if it were not decided upon for other well known reasons. Special arrangements will be provided for the carrying of the large number of deck passengers expected, while accommodation between decks will give shelter to such of them as may require it in the event of illness or bad weather. Ventilating arrangements will be fully considered, though the fitting of some of these is to be deferred until the Lady Longden has made her passage, it not being thought desirable to pierce the decks of so small a vessel more than is absolutely necessary prior to the completion of her possibly stormy run this winter through the Bay of Biscay. We have felt that the enterprising spirit shown by Mr. Tambayah in the endeavour to carry out suggestions we have previously offered is deserving of some recognition at our hands, and we heartily wish success to the Lady Longden, and the rapid development of the undertaking of which she is the pioneer ship.

THE PORT CLARENCE SALT WORKS.

Progress is now being made with the works for the utilisation of the vast deposits of salt known to be found in the south-east of Durham, and one of the pleasantest visits of the sections of the British Association was to the bore-hole that has been made for the utilisation of those deposits. When it is remembered that the production of salt for the whole of the kingdom is given by Hunt's "Mineral Statistics" as only 2,645,000 tons yearly, it will be seen that the value of an addition such as is probable from Durham can scarcely be over-estimated. It is twenty-two years since the first bore-hole was sunk on the Middlesbrough side of the Tees, to a depth of 1313ft., when a bed of salt one hundred feet thick was pierced. This boring ceased in the autumn of the year 1862, but a few years later Messrs. Bell Brothers had a test boring executed by the diamond borer to a depth of 1355ft., with a similar result. In the boring that has been this year completed, the depth has been 1120ft. A tube 16in. in diameter is carried from the surface to the bottom of the bed of salt, the part traversing the salt being pierced with apertures. Inside this tube a second tube, open at the lower end, is placed. The method of extracting the salt is to run water down the annulus formed by the two tubes, which becoming saturated with salt rises in the inner tube until it is balanced by the outer column of fresh water. The proportional weight of fresh water and brine is as 1000 to 1200, so that the inner column stands considerably below the outer. A pump is placed at the top of the inner column, and by this means the brine is raised to the surface. It is expected that this method will be at use at Saltholme, the site of the bore-hole, in the course of a few weeks, and very naturally there will be considerable interest felt in this new phase of what is an old industry in the district. For along a part of the Durham coast there are all the indications of an extensive working of the salt deposits, and in some parts of it the names of some of the processes, are left in the districts they were carried on. The utilisation of these deposits in the method described must do more than materially benefit the Durham chemical trades—it must be expected to give an immense growth to the industry. Hitherto in the southern part of Durham there has been only a very slight growth of the chemical trades, but as the deposit of salt is believed to run from Hartlepool at least to the south, it may be fairly expected that when its value is known and its benefit to the trade springing from an immense quantity of material close to it is appreciated, there should be a growth not only of salt works, but also of the many dependent chemical trades. It is too soon to speculate in more than general terms on the result; but it is one of the most singular facts connected with the commencement of the industry, that whilst thirty years ago Messrs. Bell Brothers were the first to introduce into the south-east of Durham the great iron industry, so now they are the first to practically utilise the deposits of salt that have been long known to be workable. The adventurers in this new field of industry have long had their minds fixed on it, and those who saw the core that had been extracted from the last bore-hole at the visit of the British Association can have little doubt of the result of this attempt to introduce the salt manufacture into the south-east of Durham.

EXPERIMENTS ON CHECKING RECOIL.

On Monday, September 18th, an experiment was made on checking and stopping entirely the recoil of a 6in. breech-loading gun in the Royal Arsenal, Woolwich, at the proof butts, under the direction of Sir Collingwood Dickson, K.C.B., and the Committee on Ordnance. The cause which led to the trial was the accident to the Angamos gun—*vide* Engineer, February 11th last. This gun was known to have been long fired with a recoil very much checked, and it has been held by many who ought to know best that that piece escaped from the trunnion ring, recoiling into the sea. A second splash was seen in the water on the side of the ship in front of the muzzle. This might have been caused, it was said, by the short coil which lies in front of the trunnion ring being forced against that ring and rebounding forward into the sea. Certainly that coil must have been left in the front of the trunnion ring, and if not found on the deck it must have sprung into the water on the side where the second splash was seen. There is another opinion that the gun came asunder at the trunnion ring. It appears likely that both opinions may continue to be held, as there seems no hope of recovering the gun. The experiment in the Arsenal was made with a somewhat similar gun of 6in. calibre. The recoil was checked and regulated by means of a coned valve in connection with hydraulic buffers; 34 lb. of pebble powder and a shot weighing 84 lb. were employed. The recoil was limited to 6in. for the first two rounds, 3in. for the next two, and it was altogether stopped at the fifth round. No effect was apparent on the gun or carriage, though at the last round some of the timber struts employed started. No means were employed to measure the pressure upon the trunnions or elsewhere, which in the last round must have been great. Probably the experiment may shortly be continued with more complete arrangements in this respect. It is difficult we think, however, to establish conclusions as to the Angamos gun from such a trial. The conditions may have been too near the balance of holding together or yielding to enable a similar result to be obtained in a single experiment, and with a gun of different calibre, and of course not in all respects an exact counterpart of the first one. It appears, however, for other reasons, very desirable to make experiments on this subject. Unquestionably a total absence of recoil may entail ultimate destruction of the carriage or gun, but the risk may be so insignificant that under some circumstances it may be worth while to incur it for the sake of the results obtained. At Meppen in August, 1879, Krupp exhibited some remarkable examples of pieces firing with recoil totally checked, as in the case of a 6·1in. gun of 64·9 cwt., which was fired by means of a ball-shaped muzzle, so as to pivot in a socket in an armour-plate shield, and also in that of a 3·4in. gun 14ft. 3½in. long, firing a projectile 22 lb. weight with a powder charge of 7·7 lb., which was fixed on a steel vertical pivot, which had to bear the entire shock necessary to stop the recoil. In spite of theoretical objections the performances of these guns were so remarkable as to justify the question whether the measure of destruction produced was a high price to pay for them.

THE S.S. CITY OF ROME.

This large Inman liner has now been completed, and will be ready for sea on Saturday, the 24th inst., when she will leave the Ramsden Dock, Barrow, on the first stage of her trial trip to the Clyde. Her engines, which are of the tandem direct-acting type, were tested on Monday, and on the other days of the week with results that were in every way satisfactory; and it is anticipared, so far as her mechanical appliances are concerned, she will be a great success. Thousands of people from all parts of the country have come to Barrow to view this remarkable ship. The general opinions of engineers and of those who are conversant with marine matters in general, is that from her immense length, easy lines, and yacht-like model, the City of Rome will be able, with her engines of 10,000-horse power, to attain the highest speed on record in connection with Atlantic steamships. On Wednesday, the 28th inst., a steamer will be waiting at Prince's Pier, Greenock, on the arrival of the train leaving St. Enoch's Station, Glasgow, at 8.55 a.m. to convey guests to the City of

Rome. The official trial trip, lasting six hours, will then take place, after which a tender will return to Prince's Pier to land those unable to go on the extended trip which will immediately commence, and will be down St. George's Channel to the south-west coast of Ireland, returning then to Liverpool, the ship arriving there about Friday afternoon, October 1st.

LITERATURE.

Criticisms on Stationary Steam Boilers directed expressly to Matters of Construction, Tests of Quality, and to the discriminating choice of Boilers. By W. MORGAN, F.G.S. London: *Colliery Guardian* Office. 1881.

THIS is a little book containing eighty-two pages of small type and a few engravings. We learn from the preface that it contains the substance of special lectures delivered at the Bristol School of Mines in 1880. Unpretentious as Mr. Morgan's book is, it nevertheless has much about it deserving praise. Indeed, we do not know of any treatise on steam boilers which contains so much useful information in a small space. But it must be very clearly understood that it is not, properly speaking, a treatise on steam boilers or their construction. It is rather a guide to steam users, and to those who have to buy boilers, than a work intended to instruct boiler makers. It is written in very simple style, and Mr. Morgan has not been very careful in spelling proper names. Thus, we met with Clarke for Clark, and Grieg for Greig. There are a few other inaccuracies, as for example, in the rules for finding the flow of steam through an orifice, but on the whole the book is free from errors. The most useful part is that which instructs a purchaser as to the precautions he ought to take when buying boilers, especially those which are not new. We quite agree with our author that there are excellent second-hand boilers in the market, but dealers in boilers are not always just what they ought to be.

"There are few things," writes Mr. Morgan, "in which, without the greatest care and precaution, you can more effectually bring trouble than in purchasing second-hand boilers. Dealers, who make it their business to sell them, are often endowed with a power of exciting human credulity, which is as marvellous as it is enticing. These boilers are, of course, as near perfection as possible, and the most venerable antiquity never prevents them from being nearly new." Our author hits dishonest dealers hard. We wish he had not spared the bargain hunter, who will have a cheap boiler. A case came under our observation not long since, in which a would-be purchaser was offered either or both of two second-hand boilers. Either was large enough for the intended purpose. One would have been safe at 60 lb., the other dangerous at 20 lb. The required pressure was 40 lb. The price of the good boiler was £130, that of the bad boiler £70. The purchaser called in an engineer to pronounce an opinion—the cheap boiler was condemned. Then came a suggestion from the seller that he would spend £20 on it in having some new plates put in, and certain stays renewed; the cost of the renovated boiler being £80. The engineer would not have anything to do with this arrangement. The buyer coaxed him to pass the cheap boiler, but the engineer was adamant, and the buyer left in disgust, stating that he would have neither boiler. In the end he bought the cheap boiler, and not very long since it was working at 40 lb. in the centre of a crowded district; and seeing that it is a Lancashire boiler, 28ft. by 7ft., it is well calculated to do a good deal of mischief when it explodes. Mr. Morgan takes a good deal of trouble to instruct his readers how to ascertain for themselves, in the first instance, whether a second-hand boiler is or is not likely to suit them; but after the preliminary steps have been taken, he advises that a report should be obtained from a boiler inspector or insurance company's office. "Even," says Mr. Morgan, "if a boiler is in the open yard, you cannot inspect it by going through the performance of walking around the outside, measuring it carefully with an ivory rule, and noting the dimensions with the reputed thickness of the plates in a diary or pocket-book." After this warning he goes on to explain how a boiler ought to be examined. We know of nothing published at all like this. Indeed, although our author admits that it is impossible to say anything new about steam boilers, he has succeeded in bringing together in a useful and readable form a great deal of information which is not so readily accessible as some persons may think. We can heartily recommend the work. The mistakes which it contains can do no harm either to engineers or non-professional readers. The first will detect them at once, and the others will never find them out; and, after all, some persons will maintain that opinions may differ as to whether Mr. Morgan is, after all, right or wrong.

A Treatise on Ironfounding. By CLAUDE WYLIE, Practical Iron-moulder. Sunderland: Thos. Reed and Co. London: Simpkin, Marshall, and Co.; Hamilton, Adams, and Co.; and E. and F. N. Spon. 1881.

THIS book is of that character which should be in every way encouraged. It is by a practical man, who has found by experience where difficulties occur in producing sound castings, and he addresses himself to a brief description of these, and then as far as possible explains their origin and the means of avoiding them. It is not often that practical men can be induced to write, and the author of this book gives expression to the idea that most of those—namely, moulders—who require information on ironfounding will already be versed in all the information he has to impart. Fortunately, however, Mr. Wylie has been induced by someone to write this book, and not only the young aspirants to the art of moulding and founding will find themselves much indebted to him, but the record of his experience as to the cause of defects in castings will afford assistance to engineers by showing the necessary procedure to be insisted upon in drawing up specifications. At present we have only two books on ironfounding, namely, Spretson's "Casting and Founding" and Overman's "Moulders' and Founders' Guide," an American book. There are numerous metallurgical works which contain a great deal of that information which must be possessed by the successful general ironfounder, but all these have left a want of that every-day experience of the man actually engaged in moulding and casting who has studied his art and has learned what causes failure, and, as a consequence, how to secure good instead of defective castings. Much of this Mr. Wylie's little book supplies, although the style of its composition shows that his practice with the pen is inferior to that with sand and iron.

Amongst the most frequent causes of defective castings is the want of proper ventilation of the mould or means of egress of the gases generated by the introduction of the molten iron, and on this subject the author has a good deal to say, and makes some very practical suggestions. The same may be said with respect to the rate at which moulds of different kinds and sizes should be filled, and the temperature at which the metal should be used. The difficulties which attend these matters are not merely stated and pointed out as things to be observed and avoided, but the author tells his readers the causes of the troubles, and how practical men go to work to prevent or overcome them. On scabs and scales and cold shuts, short running and drawing or sinkings, some useful information is imparted. The various systems of moulding in green sand and loam are well treated from a practical point of view. Some useful hints on the management of cupolas are given, as well as on gathering metal for large castings. The chapter on chilled castings might be usefully extended by adding some of the information given in the articles on that subject in our impressions for the 24th December, 1880, and the 7th of January last; and the chapter on malleable cast iron needs extension and revision. It is not true, for instance, that the annealing is necessarily carried out under a patented process, and the author's experience is evidently not of a practical nature on this subject. With these exceptions, and perhaps the need of a few more illustrations, the book better meets the requirements of those for whom it is chiefly intended than any yet published, for it contains more of the results of personal practical experience and workshop instruction, while it is published at a price which places it at the disposal of all who want to learn.

LIFE AMONG THE LIGHTHOUSES.

No. II.

Let us try to realise the daily work of those by whom the structures are inhabited. "You are to light the lamps every evening at sun-setting, and keep them constantly burning, bright and clear, till sun-rising." That is the first article of instruction to light-keepers, as may be seen by any visitor to a station. Whatever else happens, you are to do that. It may be you are isolated, through the long night watches, twenty miles from land, fifty or a hundred feet above the level of the sea, with the winds and waves howling round you, and the sea-birds dashing themselves to death against the gleaming lantern, like giant moths against a candle; or it may be a calm, voluptuous, moonlight night, the soft land airs laden with the perfumes of the Highland heather or the Cornish gorse, tempting you to keep your watch outside the lantern in the open gallery, instead of in your watch-room chair within. The Channel may be full of stately ships, each guided by your light, or the horizon may be bare of all sign of life, except, remote and far beneath you, the lantern of some fishing-boat at sea. But whatever may be going on outside, there is within for you the duty, simple and easy by virtue of your moral method and orderly training, "to light the lamps every evening at sun-setting, and keep them constantly burning, bright and clear, till sun-rising." You shall be helped to do this easily and well by abundant discipline, first, on probation at head-quarters, where you shall gain familiarity with all your materials—lamps, oils, wicks, lighting apparatus, revolving machinery, and cleaning stores; you shall be looked at, and over, and through, by keen medical eyes, before you can be admitted to this service, lest, under the exceptional nature of your future life, you, not being a sound man, should break down, to the public detriment and your own; you shall be enjoined "to the constant habit of cleanliness and good order in your person, and to the invariable exercise of temperance and morality in your habits and proceedings, so that by your example, you may enforce, as far as lies in your power, the observance of the same laudable conduct by your wife and family." You shall be well paid while you are hale and active, and well pensioned when you are past work; you shall be ennobled by compulsion into provident consideration for your help-mate and your children, by an insurance on your life; but when all this is done for you, and the highest and completest satisfaction that can fall to the best of us on this side the grave—the sense of being useful to our fellows—is ordered for you in abundant measure, it all recurs to what, as regards the speciality of your life, is the be-all and the end-all of your existence, and this is the burden of the ballad of your story: "You are to light the lamps every evening at sun-setting, and keep them constantly burning, bright and clear, till sun-rising."

To do this implies a perpetual watch. "He whose watch is about to end is to trim the lamps, and leave them burning in perfect order, before he quits the lantern and calls the succeeding watch; and he who has the watch at sunrise, when he has extinguished the lamps, is to commence all necessary preparations for the exhibition of the light at the ensuing sunset;" and, moreover, "no sofa, bed, or other article on which to recline, can be permitted, either in the lantern, or in the apartment under the lantern, known as the watch-room."

Thus far we have a common denominator to the life of every light-keeper; but in other respects it varies much. At some stations, as the Forelands or Harwich, where there are gardens to cultivate and plenty of land room for the men to stretch their legs and renovate themselves after the night watches; where visitors from neighbouring watering-places are constantly coming and going, to talk, to praise, to listen, and perhaps to fee, it is all very well; but there are also places "remote, unfriended, melancholy, slow," where the walk is limited to the circle of the gallery railing, or the diameter of the lighthouse column; where the only incidents are the inspections of the committee, the visits of the district superintendent, or the monthly relief which takes the men back to shore. At these stations, when the sea is making fun of them, it sweeps up clean over the roof, and makes the lantern-glasses ring again, and in calmer weather the men may creep carefully out upon the rock to solace themselves with a little fishing; or if of more nervous temperament, may do it, as Winstanley did, with greater security from the kitchen window.

Not but that some people like this sort of life. Smeaton tells a story of a shoemaker who went out as light-keeper to the Eddystone because he did not like confinement, having found himself in effect a greater prisoner at his lapstone than he would be at the rock; but then Smeaton confesses a few pages farther on that at times the keepers have been so short of provisions as to be compelled to eat the candles.

In the old days of private proprietorship, when every owner had his system of management, and when the desire to make a profit set the aims of efficiency and economy into antagonism, exceptional cases of very terrible tragic significance occasionally occurred. In 1802, the watch on the "Smalls" was kept by two keepers; and for four months the weather shut them off from all communication with the land. The method of talking by signals was not developed anywhere into the complete system it has now become, and does not appear to have been in use at all among the lighthouse people; but in the course of a week or two after the storm had set in, it was rumoured at several of the western ports that something was wrong at the Smalls. Passing vessels reported that a signal of distress was out; but that was all they knew. Many attempts to approach the rock were made, but fruitlessly. The boats could not get near enough to hail; they could only return to make the bewildered agent and the anxious relatives of the keepers more bewildered and more anxious by the statement that there was always what seemed to be the dim figure of a man in one corner of the outside gallery, but whether he spoke or moved or not they could not tell. Night after night the light was watched for with great misgiving whether it would ever show again. But the light failed not. Punctually as the sun set it seemed to leave a fragment of its fire gleaming in the lantern-glasses, which burnt there till it rose again, showing this much at least—that some one was alive at the Smalls; but whether both the men, or which, no anxious mother or loving wife could tell. Four months of this, and then, in calmer weather, a Milford boat brought into the agency, at Solva, one light-keeper and one dead man.

What the living man had suffered can never now be known. Whether, when first he came distinctly to believe his comrade would die, he stood in blank despair, or whether he implored him on his knees, in an agony of selfish terror, to live; whether when, perhaps for the first time in his life, he stood face to face, and so very close, to death, he thought of immediate burial, or whether he rushed at once to the gallery to shout out to the nearest sail, perhaps a mile away; at what exact moment it was that the thought flashed across him that he must not bury the body in the sea, lest those on shore should question him as Cain was questioned for his brother, and he, failing to produce him, should be branded with Cain's curse, and meet a speedier fate—is unrecorded. What he did was to make a coffin. He had been a cooper by trade, and by breaking up a bulkhead in the living room, he got the dead man covered in; then, with infinite labour, he took him to the gallery, and lashed him there. Perhaps with an instinctive wisdom he set himself to work, cleaned and recleaned his lamps, unpacked and packed his stores. Perhaps he made a point of walking resolutely up to the coffin three or four times a day; perhaps he never went near it, and even managed to look over it, rather than at it, when he was scanning the whole horizon for a sail. In his desperation it may have occurred to him that, as his light was a warning to keep vessels off, so its absence would speedily betray some ship to a dangerous vicinity to his forlornness, whose crew would be companions to him, even though he had caused them to be wrecked. But this he did not do. No lives were risked to alleviate his desolation; but when he came on shore with his dead companion, he was a sad, reserved, emaciated man, so strangely worn that his associates did not know him. The immediate result of this sad occurrence was, that three men were always kept at the lighthouse; and this wise rule pertains in the public service.

Midway between a rock lighthouse and a shore station, both as to structure and as to the experiences of life in it, is that mongrel-breed among edifices the pile lighthouse. There are many sands at the mouths of tidal rivers where the water is not deep enough, nor are the channels sufficiently wide, to make a light-vessel suitable, and which yet need marking, and marking, too, at a spot where not only the ordinary foundations of masonry, but even the pile foundations used for many purposes, would be at fault. Here it is that two very ingenious plans have been of service. The one is to fit the lower extremity of piles with broad-flanged screws, something like the screw of a steam-vessel, and then, setting them upright in the sand, screw them down with capstans worked from the decks of dumb lighters. These bottom piles once secured, the spider legs are bolted on to them, and the spider bodies on the top; a ladder draws up, and a boat swings ready to be lowered. The other mode of meeting the difficulty of mud or loose silt and sand, is by hollow cylinders, which, placed upright on the sand, have the air exhausted from the inside of them, and the weight of the atmosphere on the sand outside forces it up into the exhausted receiver, and the pile sinks at a rate which, until one gets accustomed to it, is rather surprising. Here, as in the screw pile, the foundation once established, the superstructure, whether of straight shafts or spider legs, is only a matter of detail.

These, then, be the variations of lighthouse structure:

Rock lighthouses—solitary giants rising from the ocean deeps; pile lighthouses, stuck about the shallow estuaries on long red legs, like so many flamingoes fishing—safer, but with less of dignity and more of ague; and lastly, the real *bonâ fide* shore lighthouse, with its broad sweep of down, its neat cottages, and trim inclosures.

The French, from economical reasons, early gave their attention to the use of seed oils, and the first developments of the moderator lamp of the drawing-room are exclusively French. There were many difficulties in the way of applying it to lighthouses until it had been greatly simplified, because the fact of the Carcel lamp being a somewhat complicated piece of machinery was against its use in places where, if anything went wrong, it might be a month or two before the weather would admit of the light-keepers being relieved, and give them an opportunity of exchanging old lamps for new. The thing was done at last by a simple but very beautiful adjustment of the argand reservoir, under which the prime condition for all good combustion was attained—namely, that the oil just about to be burnt should be gasified and prepared for burning by the action of the heat of that which is at the moment being consumed; and so great is the quantity of oil used in the three kingdoms, that this change from sperm to rapeseed oil must have effected a saving of many thousands a year.

But if oil, from its portability and comparative simplicity, has become the standard material for light in lighthouses, and has been the object of a thousand and one nice adaptations in regard to its preparation and the machinery by which it is consumed, the attention of very able men has been given to other sources of illumination. One of these was known as the Bude light, and consisted of jets of oxygen introduced into the centre of oil wicks, producing an intense combustion, which turned steel wire into fireworks, but requiring great management to avoid smoking and charring. It was finally regarded as unsuitable, on account of the manufacture of the gas and its niceties of chemical manipulation. The lime lights, of which there are several, are substantially the same in this, that oxygen and hydrogen gases have to be made—in the vicinity of gasworks the common gas will do for the hydrogen—and are burnt together upon lime or some analogous preparation.

The first electric lights were galvanic. The light, developed between carbon points, was generated by a galvanic battery. Flickering, intermittent, and uncertain, the light was yet sufficiently astonishing, and when it came to be discovered that the residuum from the decomposition was valuable for making costly colours, the Electric Power, Light, and Colour Company offered to sell the mere light at a very low rate; but the difficulties in the way were insuperable—the manipulation of the batteries was somewhat nice and markedly unhealthy, the flickering was objectionable, and the light, though intense, was so extremely minute that the shadows of the framework of the lantern glasses widened outwards in a way that would have covered the horizon seaward with broad bands of darkness. But the matter was not to stop here. In 1831 it had been discovered by Faraday that when a piece of soft iron, surrounded by a metallic wire, was passed by the poles of a magnet, an electric current was produced in the wire, which could be exalted so as to give a spark; and upon this hint an apparatus was constructed, consisting of an accumulation of powerful magnets and iron cores with surrounding coils. This apparatus, modified and improved, driven by steam engines, and fitted with a subtle ingenuity of resource — always tending to simplicity—is at this moment at work, and very glorious is the result to the eye of the observer.

The chief point to be determined is its power over fogs. That any light will penetrate through some fogs is out of the question. The sun himself cannot do it. But the artificial light that can hold out longest and pierce the farthest is clearly the light, at all costs, for the turning points in the great ocean highways. A success of this kind would create something of a revolution in a branch of lighthouse art, on which a vast amount of ingenuity and even genius has been expended; that is, the apparatus by which the light should be exhibited. There may be divisions among scientific men as to the abstract nature and action of light, but sufficient of its secondary laws is known to make various arrangements in regard to the management of a generated light most valuable. The old plan known in scientific nomenclature as the Catoptric system, is by reflection. Take a bowl of copper—something like a wash-hand basin—and having shaped it carefully into a parabolic curve and then silvered and polished the interior, set it up on its side and introduce an argand lamp into it, so that the flame of the lamp shall be in true focus, and we have a reflecting apparatus. This may be multiplied in double and triple rows, and may be either placed upon flat faces or curved to the circle, but a lamp in the centre of a reflector is the basis of the arrangement. If a light were put upon a rock in the ocean without a reflector it would be seen dimly but all around. Dimly, because the light spreading in all directions, would be weak and diluted; but visible all around because there would be nothing to obstruct it. But put this light into a 21in. reflector, and we have two distinct consequences; one that we obstruct the radiation of all the rays except those that escape from the mouth of the reflector; the other, that we reflect into the same direction as the rays that are escaping all those we have obstructed from their natural radiation.

A 21in. reflector allows the rays issuing from it to diverge 15 deg. So that we have the light of the 360 deg.—the whole of the circle—gathered into fifteen—a twenty-fourth part of the circle. It does not quite follow that within that area the light will be twenty-four times as strong as if allowed to dissipate itself all round, because something must be allowed for absorption and waste; but we believe this allowance has been greatly overstated, and that where there are no mechanical difficulties in the way the reflecting system is decidedly the best. Of course, where it is necessary to light more than 15 deg. of the circle it will be necessary to use more reflectors, placing them side by side round a shaft, and if these are set into revolving motion, focus after focus of each reflector comes before the eye of the mariner, and the effect is all that can be desired.

The dioptric, or refracting system of lighting, is the reverse of this. In the reflector the light is caught into a basin and thrown out again; in the refracting system, in its passage through the glass prisms, it is bent up or down and falls full upon the eye of the mariner, instead of wasting itself among the stars or down among the rocks at the lighthouse foot. For light, falling upon glass at a certain angle, does not go straight on, but gets deflected and transmitted in an altered line, as it does through water. And here comes the weakness of the dioptric system, in close vicinity to its strength. It is true that prisms and lenses send the light in the direction which is desired, but they charge a toll for the transmission; the glass is thick, and somewhat of the nature of a sponge. If we write on blotting-paper the marks appear on the other side, but some of the ink has soaked sideways; and there is very little doubt that when light is transmitted through glass a good deal of it is absorbed and retained.

To those who have never seen a dioptric apparatus, or a diagram of one, it would be very difficult to make a written description intelligible. The reader must imagine a central lamp, with three or four circular wicks, making up a core of light 4in. across, and as many high. Round this, and on a level with it, at a distance of 3ft. from it, go belts of glass. From these belts, or panels, the light goes straight out to sea, but as there is a great quantity of light which goes up to the ceiling and down to the floor, rings of prisms are put above and below the main panels, and these catch the upper and lower light and bend it out to sea, parallel to the main central beam. When a revolving light has to be made by the dioptric apparatus, the lenses are so constructed that the light in going through them is gathered up into the exact similitude of a ray, as it would leave the mouth of a reflector, and of course with the same result; the central lamp remains stationary, and the lenses move round it, and focus after focus, flash after flash, come upon the eye of the mariner. Both the systems admit of peculiar adaptations, and they have been occasionally combined into a hybrid apparatus called cata-dioptric.

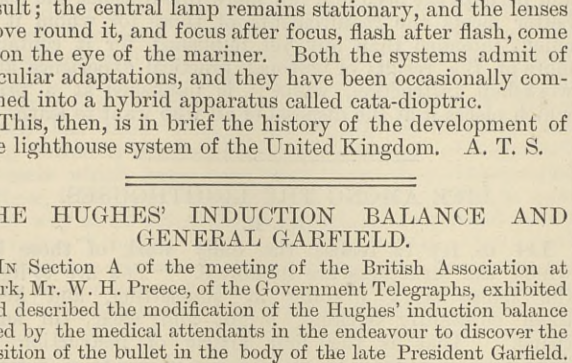
This, then, is in brief the history of the development of the lighthouse system of the United Kingdom. A. T. S.

THE HUGHES' INDUCTION BALANCE AND GENERAL GARFIELD.

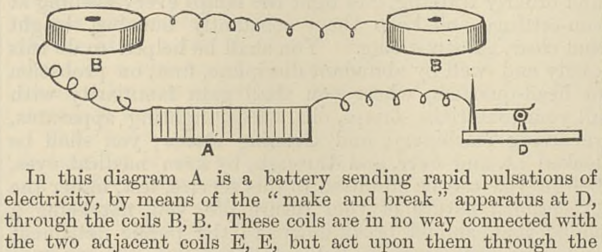
In Section A of the meeting of the British Association at York, Mr. W. H. Preece, of the Government Telegraphs, exhibited and described the modification of the Hughes' induction balance used by the medical attendants in the endeavour to discover the position of the bullet in the body of the late President Garfield. Mr. Preece's lecture is invested with a special and melancholy interest at this moment.

The remarks of Mr. Preece may be prefaced by the description of the original instrument given by Professor Tyndall at the close of the Royal Institution session. Professor Tyndall exhibited the accompanying diagram—Fig. 1—to explain the principle of construction of the apparatus:—

FIG. I



In this diagram A is a battery sending rapid pulsations of electricity, by means of the "make and break" apparatus at D, through the coils B, B. These coils are in no way connected with the two adjacent coils E, E, but act upon them through the intervening space by induction. F is a loud-speaking telephone, which under normal conditions emits no sound, since the two coils E, E, are so joined up as to oppose and balance each other. But let a piece of metal be placed in one of the coils marked E, the magnetic field of the coil is modified; some of the induced electrical pulsations then find their way through the telephone F, which then makes a singing noise, audible all over the theatre. Let an exactly similar piece of metal be placed in the other coil E, the two coils will again balance each other, silence being the result. Professor Tyndall remarked that the instrument was one of astonishing delicacy. Good from bad money could be told by its aid. If a good shilling were used in the attempt to balance a bad one, the sounding telephone would reveal the fact. The accompanying cut, Fig. 2, is a copy of the diagram exhibited by Mr. Preece at York. The principle of the arrange-



ment in Fig. 2 is the same as that represented in Fig. 1, except that the telephone is an ordinary one, and has to be applied to the ear, and the two coils A a are movable. Their external appearance is represented by x y, Fig. 3; they are moved about by a handle in search of the bullet A, and when A is opposite the centre of the coils the telephone gives its loudest sound. The diameter x y is about 5in.

Mr. Preece said that in the case of President Garfield, it was necessary to have if possible an invisible and impalpable probe, one which could not be felt, to search for the bullet. Professor Graham Bell conceived that the Hughes' induction balance might be modified to achieve the purpose; the same idea was also conceived by Professor Rowland, of Baltimore. Professor Bell telegraphed to him—Mr. Preece—to consult Professor Hughes as to the feasibility of using the induction balance, and Professor Hughes adopted the idea with enthusiasm; he spent day and night in working it out practically, and finally sent the details of his results to Professor Bell, who, with another, had been working independently at the matter.

Mr. Preece then took the coils represented in Fig. 3, and gave Sir William Thomson, the chairman, the telephone connected with them. When Mr. Preece brought the centre of the coils over an iron screw, at a distance of from 2in. to 3in., the chairman said that he heard the sounding of the telephone. The same experiment was made with Mr. Swan, who gave the same testimony. Mr. Preece continued that Professor Hughes had discovered coins concealed in various boxes by Fellows of the Royal Society; he applied the instrument and selected the right boxes as cleverly as if he had been a conjuror. Mr. Preece then asked Sir William Thomson to conceal a bullet in one of his hands; he next proceeded, by the aid of the coils, to discover which hand it was in, after first remarking—conjuring fashion—to the listeners, "I assure you there is collusion." Sir William Thomson in turn successfully discovered bullets in Mr. Preece's hands; the latter remarked that the chairman had never seen or tried to use the instrument before. He added that Professor Hughes was able to detect a bullet at a distance of 3in., and Mr. Bell had made an instrument which would detect a bullet 5in. off. Medical men, however, desired not only to be able to detect the presence of bullets, but their locality. The plan of action was, first to get the bullet within the line of axis of the coils; this was done when the telephone gave its maximum sound. Then a second bullet, exactly the same as the first one, was brought opposite the other pair of coils, until it was at such distance as to neutralise the effect of the first one. Professor Bell's report to the surgeons in attendance on President Garfield was interesting. He said:—"I beg to submit for your information a brief statement of the results obtained here with a new form of induction balance in the experiments made this morning for the purpose of locating the bullet in the person of the President. The instrument was tested for sensitiveness several times, and during the course of the experiments it was found to respond well to the presentation of a flattened bullet at a distance of about 4in. from the coils. When the exploring coils were passed over part of the abdomen where a sonorous spot was observed in the experiments made on July 26th, a feeble tone was perceived, but the effect was audible a considerable distance around this spot." The sounds, continued Mr. Preece, were too feeble to be entirely satisfactory, as he had reason to expect from the extreme sensitiveness of the instrument a much more marked effect. In order to ascertain whether similar sounds might not be obtained in other localities, he explored the whole right side and back below the point of entrance of the bullet, but no part gave any indications of the presence of metal except an area of about 2in. in diameter, containing within it the spot previously found to be sonorous. The experiments were repeated by Mr. Tainter, who obtained exactly corresponding results. They were, therefore, justified in concluding that the ball was located within the above-named area. In the preliminary experiments it was found that a bullet like the one in question, in its normal shape, produced no audible effect beyond a distance of 2½in., while the same bullet flattened and presented with its face parallel to the plane of the coils gave indications up to a distance of nearly 5in. The same flattened bullet held with its face perpendicular to the same plane of the coils produced no sound beyond a distance of 1in. These facts proved that in ignorance of the actual shape and mode of presentation of the bullet to the exploring instrument, the depth of which the bullet is beneath the surface cannot be determined from their experiments. Much remained to be done to render the instrument practical and useful, but nevertheless they had clear evidence of a new application of electricity, which would be beneficial and valuable.

Professor Rowland, of Baltimore, who was present in the Section, said that he had recently visited Mr. Bell's laboratory in Washington, and had suggested to him the use of an electrical condenser in the instrument; this had been tried, and had doubled the distance at which the apparatus could indicate the presence of a bullet. He believed that Mr. Bell had since modified the instrument by making the primary coil slip over the secondary one, until a point was reached at which the sound ceased.

Mr. W. H. B. Coffin remarked that the instrument required that the one bullet, out of sight, should be balanced by one exactly like it, and as it was impossible to say the first one had not been flattened, the instrument was not precise enough to be of much use. The ignorance of medical men about electricity was surprising.

After a few remarks from Professor Everett and Dr. O. Lodge, the next subject in the list was called on.

South Kensington Museum.—Visitors during the week ending Sept. 17th, 1881:—On Monday, Tuesday, and Saturday, free, from 10 a.m to 10 p.m., Museum, 12,186; mercantile marine, building materials, and other collections, 5656. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. till 5 p.m., Museum, 1867; mercantile marine, building materials, and other collections, 643. Total, 20,352. Average of corresponding week in former years, 18,781. Total from the opening of the Museum, 20,358,616.

The Derwent Iron Company.—Negotiations have been going on for some months past for the purpose of effecting an amalgamation between the Derwent Hematite Iron Company, of Workington, which is a company composed of a number of Scotch gentlemen, and which has been most successfully carried on since its establishment between seven and eight years ago, and the well-known firm of Messrs. Wilson, Cammell, and Co., of Dronfield Steel Works. These negotiations, are now almost complete. The Derwent Company is most fortunately situated, having somewhere about sixty acres of land, one-half of which is freehold, the whole of the ground abutting on the sea; while a tramway runs from the works, a distance of about one and a-half miles, to the harbour, where most complete apparatus has been erected for loading vessels, the tramway, &c., being the property of the company. The works consist of three furnaces, two of which are at present in blast. There are also excellent sidings from the London and North-Western Railway, and also from the Cleator and Workington Junction Railway. We understand it is the intention of Messrs. Wilson, Cammell, and Co. to remove the whole of their plant to this district as soon as the negotiations are brought to a successful issue, the reason given for the removal being the heavy cost of carrying hematite steel to Sheffield, and after manufacture, to the seaboard. It is currently rumoured that another firm from the Midlands is about to follow the example of Messrs. Wilson, Cammell, and Co., and a few days ago several gentlemen were engaged on the north side of Barrow, looking out ground for the establishment of a similar works on behalf of a Scotch company.

AVERAGE CONSUMPTION OF COAL PER INDICATED HORSE-POWER PER HOUR, BY STEAMSHIPS WITH COMPOUND ENGINES IN LONG SEA VOYAGES.

From Mr. Marshall's paper on "The Progress and Development of the Marine Engine," read before the Institution of Mechanical Engineers, at Newcastle.—(See page 225.)

Engines.										Boilers.												Performance.			
		Cylinders.								Shell.		Furnaces.		Tubes.				Heating surface					Coal consumption.		
		Diameter.																							
Number.	Class.	High pressure.	Low pressure.	Stroke.	Piston speed per minute.	Condensing surface.	Diameter of screw propeller.	Working pressure above atmosphere.	Number of boilers.	Diameter.	Length,	Total number.	Diameter.	Total number.	Length.	Outside diameter.	Total firegrate area.	Tubes.	Furnaces, &c.	Total.	Heating surface per indicated horse-power.	Indicated horse-power.	In twenty-four hours.	Per I.H.P. per hour.	Heating surface per lb. of coal per hour.
		in.	in.	in.	ft.	sq. ft.	ft. in.	lb.		ft. in.	ft. in.		ft. in.		ft. in.	in.	sq. ft.	sq. ft.	sq. ft.	sq. ft.	sq. ft.	I.H.P.	tons.	lb.	sq. ft.
1	A	34	61	45	450	2466	15 3	70	2	12 0	15 0	8	3 6	800	6 0	3	140	3688	528	4216	4·68	900	14·5	*1·50	3·12
2	A	42	80	48	552	..	..	72·5	2	13 6	18 6	..	..	..	..	..	..	..	..	6000	3·19	1881	32·25	1·60	1·993
3	A	35	70	48	400	2400	17 0	90	2	11 6	18 6	8	3 6	640	6 10	3½	160	3814	626	4440	3·7	1200	21	1·63	2·265
4	A	46	87	57	484	5000	19 0	80	3	12 3	18 6	12	3 9	1164	6 7	3¼	250	6420	1383	7803	3·545	2200	40	1·66	2·136
5	A	22	44	30	360	705	11 0	100	1	12 8	11 6	3	3 0	172	7 3	3¼	49·5	1060	342	1402	3·34	420	7·5	1·67	2·0
6	A	50	86	54	540	4865	17 6	72	4	{W13 4½ / H16 0¾}	10 0¾	12	3 6	1024	7 0	3½	273	6530	1192	7722	2·88	2677	48	1·67	1·725
7	A	35	70	48	424	2000	17 0	90	2	9 6	18 6	8	3 6	608	6 10⅜	3½	150	3822	952	4774	3·97	1200	21·5	1·69	2·35
8	A	54	94	60	530	7420	18 3½	75	6	12 9	10 6	18	3 2	1308	7 6	3½	313	8983	1856	10839	4·9	2207	40·3	1·7	2·88
9	A	54	94	60	486	7422	18 0	82·5	6	12 9	10 6	18	3 2	1266	7 6	3½	324	8735	2605	11340	6·3	1801	32·8	1·7	3·705
10	A	30	58	39	400	1518	14 2	80	2	12 0	10 6	4	3 2	344	7 3	3¼	69·64	2120	488	2608	4	650	12	1·72	2·34
11	A	29	56	33	350	1250	13 3	70	2	11 0	10 6	4	3 0	316	7 0½	3¼	66·0	1891	488	2379	4·74	500	9·5	1·76	2·69
12	A	34	66	42	406	1700	15 6	80	2	13 4	10 6	6	3 3	352	7 3	3½	107·25	2708	766	3474	3·975	875	16·5	1·76	2·27
13	A	36	68	42	434	1821	16 3	77	2	14 4½	10 3	6	3 4	460	7 0	3½	110	2950	764	3714	4·34	854	16·75	1·763	2·46
14	A	54	97	60	480	7427	18 10½	70	6	15 10½	10 6	18	3 2	1314	7 6	3½	329	9198	1847	11045	5·52	2000	38·6	1·80	3·065
15	A	51	88	60	590	5000	17 6	75	4	{W15 6 / H18 6}	10 9	12	4 2	1224	7 0	3½	332·5	7850	1398	9248	3·365	2745	54	1·83	1·839
16	A	28	53	38	380	1560	14 0	75	2	12 1	9 5	4	3 3	328	7 0	3½	78	2050	383	2433	4·34	560	11	1·84	2·36
17	A	50	86	54	540	5500	17 6	70	4	{W13 8 / H17 3}	10 0	12	3 6	1016	7 0	3½	273	6393	1132	7525	3·105	2422	48	1·85	1·647
18	A	38	70	48	416	2600	17 9	80	..	..	..	..	..	..	..	..	65	..	..	4864	4·18	1160	23	1·85	2·26
19	A	35	70	48	408	2005	17 0	90	2	11 6	18 6	8	3 5	616	6 10⅜	3½	150	3872	954	4826	4·39	1099	22	1·87	2·35
20	A	35	70	48	440	2000	20 9	90	2	10 11	18 6	8	3 3	544	6 9	3½	136	3384	1012	4396	3·875	1135	23	1·89	2·05
21	A	34½	64	42	500	1647	15 4	80	2	9 6	13 0	8	2 8	368	6 9	3½	106	2332	618	2950	3·35	880	18	1·90	1·762
22	A	48	84	60	550	4468	19 0	70	3	{W11 9 / H14 3}	16 6	18	3 2	1140	6 9	3½	340	7153	1047	8200	3·56	2300	47	1·90	1·873
23	A	50	86	54	510	4842	17 9	70	6	11 3¼	9 10	18	3 0	1188	7 0	3½	310	7603	2236	9839	4·44	2213	43·5	1·90	2·34
24	A	54	94	60	441	7420	17 9	70	6	12 9	10 6	18	3 2	1326	7 6	3½	312	9149	2601	11750	4·9	2400	48·9	1·90	2·58
25	A	56	97	54	504	5000	18 6	70	6	13 0	10 3	18	3 3	1062	7 3	3½	292	6913	1302	8215	3·282	2500	51·9	1·93	1·70
26	A	30	60	36	372	1600	13 0	90	2	11 3	9 7	6	3 2½	360	6 8	3½	115	2230	523	2753	4·59	600	12·5	1·945	2·36
27	A	36	70	45	560	2900	13 0	75	2	13 0	14 0	12	3 1	912	5 4	3	166	3884	738	4622	2·88	1600	32	†2·0	1·44
28	A	36	64	36	450	2059	13 0	70	2	13 0	9 4	6	3 2	380	6 4	3½	106	2272	582	2854	2·795	1020	22	†2·125	1·315
29	A	36	68	42	530	2500	13 0	70	2	14 0	11 0	6	3 6	408	7 0	3½	130	2876	586	3462	2·77	1250	29	†2·25	1·23
30	A	36	67	42	530	2400	13 0	70	2	14 0	11 0	6	3 6	..	7 0	3½	129	2866	585	3451	2·8	1230	28	†2·25	1·243
Mean	..	..	..	..	467			77·4													3·917			1·828	2·178
31	C	48	83	60	523	9000	23 6	70	8	{W14 4½ / H 9 0}	19 10	32	3 3	2432	7 2	3½	624	15783	3321	19104	3·9	4900	93	1·77	2·2
32	B	26	58	45	444	1700	15 0	80	2	13 4	9 6	6	3 0	472	6 6	3½	99	2566	594	3160	3·85	820	16·75	1·90	2·026
33	B	27	56	52	395	1730	15 9	80	1	{W12 0 / H14 2}	24 0	6	3 4	284	9 0	4	102	2675	569	3244	4·45	730	15·1	1·92	2·32
34	B	27	56	52	412	1650	15 9	75	1	..	..	6	3 4	296	9 0	4	102	2750	820	3570	4·63	771	16	1·93	2·4
35	C	28	60	54	504	4100	20 0	90	3	11 6	17 6	18	2 10	1116	6 6	3½	300	6165	1235	7400	3·89	1900	40	1·96	1·986
36	C	28	60	54	522	4100	20 0	80	3	11 6	17 6	18	2 10	1116	6 6	3½	302	6171	1243	7413	4·0	1850	40	2·01	1·95
37	C	16	34	30	360	768	12 6	68	1	9 10	13 0	3	3 2	150	6 6	4	47·25	1004	346	1350	5·0	270	7	2·25	2·22
38	C	26	52	42	336	2400	17 3	70	2	10 9	17 0	8	3 1	544	6 1	3½	132	3033	617	3650	4·06	900	24	2·47	1·641
										W = width H = height															
Mean	..	..	..	..	437			76·6													4·22			2·026	2·096
39	D	62	{90 / 90}	66	605		21 0	90	7	13 6	{six 18 0 / one 10 0}	39	3 3	2522	7 0	3½	780	16200	3300	19500	3·09	6300	110	1·634	1·52

Class A—Compound engines with one high and one low-pressure vertical cylinder, working two cranks at right angles.
,, B ,, ,, one ,, one ,, ,, ,, one crank. Cylinders in line (tandem).
,, C ,, ,, two ,, two ,, ,, ,, two cranks at right angles. Cylinders in line (tandem).
,, D ,, ,, one ,, two ,, ,, ,, three cranks at 120 deg.

* Always working with early cut-off engines never pressed. Welsh coal.

† These four ships are very limited in boiler power.

ON THE "SWAN" INCANDESCENT LAMP.*

By J. W. SWAN.

EVER since Sir Humphrey Davy showed that a brilliant and continuous light could be produced by causing the current from a voltaic battery to pass between two points of charcoal, the application of electric light to useful purposes has been one of the chief aims of electrical experimentalists. But it is within the last twenty years—or since mechanicians and electricians combined to make it possible to produce electricity by mechanical means—that the idea of useful electric illumination has been brought within the scope of practicability.

The great difficulty in producing electric light with carbon points was to make it steady and to moderate its excessive brilliance. By dint of improvement in the form and quality of the charcoal pencils, and ingenious mechanism for maintaining the points of these pencils at one constant distance from each other, the first of these difficulties has, to a very large extent, been overcome; but the second remained, and must remain, as an insuperable obstacle to the application of this form of electric light to the general purposes of artificial illumination. That form of electric light applied to the illumination of railway stations, streets, &c., is only exceptionally applicable, leaving the greater number and the more important of our wants, in respect of artifical light, unprovided for.

I do not intend to convey the opinion that the form of electric light to which I am referring is not in some cases a useful form. It would be absurd to express such an opinion in the presence of those who have witnessed the splendid illumination of the railway stations and streets of London by those means. What I say is this—that that form of electric light is only exceptionally applicable, and that it leaves the greater number and the more important of our wants in respect of artificial light unprovided for. It is, in my opinion, inapplicable to domestic lighting, and it is that we experience most keenly the evils of the existing modes of artificial illumination by means of gas and oil lamps.

In order to adapt the electric light to house illumination it is necessary to entirely change the method of producing it. Starr was the first to conceive the idea that it might be possible to produce an electric light both small and steady by heating to a white heat a thin piece of carbon. Starr's proposal was to put a thin plate of carbon in the vacuum of a mercury barometer, and to keep it in a state of white heat by passing an electric current through it. The difference between the two systems I have mentioned is this:—In the first, on which the light is produced by a disruptive electric discharge between points of carbon, there is a break in the circuit—so far as solid material is concerned—at the place where the light occurs. In the other the solid conductor is quite continuous; but at the place where the light is produced the conductor has a high degree of resistance. At that place the conductor is carbon, and as carbon is, comparatively with metals, a bad conductor, it happens that when an electric current is forced through this circuit a certain amount of electricity is converted into heat in the carbon. If the quantity which passes in a given time is large enough in proportion to the mass of carbon it becomes white hot and emits light. Electric light produced on this principle of incandesence has many good properties which the electric light known as the "arc" light had not. If the electric current which produces the incandescence is quite constant, the light emitted by the white carbon is absolutely constant; there is not the slightest flicker or variation in it. It is, moreover, quite under control as to its brilliance, and must be made as yellow as gaslight or as white almost as sunlight. It communicates no noxious vapours to the air, and is not too costly. But the crowning merit of electric light produced on the principle of incandescence is that it is indefinitely divisible without sacrifice of economy. A lamp may be so constructed as to give a light of ten candles, or it might be constructed with larger carbon conductors so as to obtain a light of one hundred candles from the incandescent carbon, and the smaller lamp will be almost as economical as the larger, light for light; that is, the ten-candle lamp will only use one-tenth of the power, and therefore cost one-tenth of the amount to maintain it, that is required by the lamp which gives ten times the light. This property of divisibility into as small centres of illumination as may be required, combined with the steadiness of this species of light, its good colour, and its wholesomeness, give it a character of general applicability which is not possessed by any other electric light. It is forty years since Starr, through his agent, King, took out his patent for producing light on this principle. It is only within the last two or three years that the many practical difficulties that beset the utilisation of this method have been surmounted. Nothing can well be simpler than the ideal incandescence lamp. A slip of carbon in a vacuum—that is all. To realise this idea much experimentation had to be gone through and much disappointment to be suffered.

* The British Association, Section G.

Starr did not make his lamp practical. Lodyguine, Konn, Sawyer, and Mann tried long and patiently to render it practical, but they did not quite succeed. The first difficulty was with the vacuum. In the vacuum lamps of earlier date it was neither possible to produce nor to maintain a perfect vacuum; there were always screws and washers about them, and these and the carbon itself, in a cold state, formed a reservoir of air quite sufficient to cause the disintegration and rupture of the carbon after a few hours' ignition. Besides this difficulty of the carbon soon breaking, there was a further difficulty in the blackening of the glass enclosure.

From elaborate experiments made by M. Fontain, and published in his work on electric lighting, the conclusion was arrived at that the blackening of the lamp-bells was due to the volatilisation of carbon, and that the breakage of the carbon was also a consequence of this action—objections, if valid, quite final to the practicability of this method. In short, at the period of these experiments, four or five yaars ago, electric lighting by the incandescence of carbon *in vacuo* was completely discredited by the crudity of all the attempts that had been made to apply the principle, by the fallacies which had grown out of these unsuccessful attempts, and which had obtained general acceptance; so much so that, in the report of the Select Committee of the House of Commons on electric lighting, issued in June, 1879, and in connection with which evidence was given by all the highest electrical authorities at that time, there is no mention whatever even of the possibility of producing light in this way. I saw reasons for doubting the soundness of M. Fontain's conclusions with respect to the cause of the breakage of the carbon in incandescent lamps, and nearly four years ago I proceeded to test them by experiment. My main idea was to employ a good Sprengel pump vacuum—a form of carbon made by carbonising paper at a high temperature with which I had experimented many years before. By this form of carbon I hoped to obtain economy in the light, because, as it was very thin, a small current would make a strip of it white hot. The carrying out of this idea was made easy by the assistance I received from Mr. Stearn. Mr. Stearn undertook to mount some of my papers in a good vacuum, and after many failures from carbons breaking he at last succeeded in making some bulbs very highly exhausted, containing my paper carbons, attached by electrically-deposited copper to platinum strips, which carried the current in and out of the lamp. I had the pleasure, in February, 1879, of showing to the president of this section—Sir William Armstrong—a lamp made in this way.

In making these experiments I do not confine myself exclusively to the use of paper carbon. The lamp as constructed for me by Mr. Stearn was extremely simple. It consisted merely of a highly-exhausted glass bulb, into which were sealed by fusion of the glass two platinum conductors supporting the carbon. This simple form of lamp I showed lighted at a lecture which I delivered before the Literary and Philosophical Society of Newcastle, in February, 1879. The final result of our experiments was that when the vacuum was good the carbon did not appreciably wear away, and that when the contact between the ends of the carbon and the metallic conductors was good the globes did not blacken. Henceforth it was possible to produce a durable electric lamp that emitted a steady light of moderate power.

Soon after this—and I am quite sure without knowing what I was doing—Mr. Edison produced a lamp identical with mine in all essential particulars. It, too, consisted of a simple bulb from which the air had been exhausted by the Sprengel pump, and which, like mine, had no screw-closed openings nor complications of any kind, but contained simply the in-going and out-going wires sealed into the glass, with the carbon attached to them. Since then the manufacture of lamps on this principle, with slight modifications in the material out of which the carbon is made, and the manner of making it, has been established on an extensive scale, both in England and America; and in the Electrical Exhibition now open in Paris electric light produced by incandescence occupies an important position. Already in this country the method has been put in actual use in house illumination and for lighting the saloons of passenger steamers. It has also been tried experimentally in coal mines. The success which has attended these applications is such as to render the subject one of great interest to mechanical engineers; for until that great discovery is made, of the possibility of which the president has spoken in his opening address—when electricity shall be produced by direct conversion of heat into electricity with smaller loss of energy than is involved in its conversion into motive power through steam—until this revolutionary change is made, we shall have to look, perhaps not entirely but mainly, to motive power and to mechanical engineers for the apparatus wherewith to produce the electricity required for electric lighting. Mr. Swan here exhibited one of his lamps, and minutely described the various parts explaining the method adopted in the preparation of the carbon and the special advantages derived. The amount of light that can be obtained from one of my lamps obviously depends on the superficial area of the carbon and the temperature to which it is heated; but the amount of light emitted by a hot body increases in a greater degree than the temperature. Evidently, therefore, the hotter it can be made the better for economy. By sending enough current through the carbon its temperature can be raised to such a point as produces a light rivalling in intensity the "arc" light. So much as 500-candle light has been obtained from one of my small lamps when pushed to its utmost limit of endurance. But the lamps are not durable at the enormously high temperature that produces this light. The lamp that would, if pressed with current to the breaking point, give a light of 500 candles, would be durable while giving a light of 50 candles. A very much larger return of light for power expended can be obtained if the durability of the lamp is disregarded than if durability is considered. Sir William Thomson and Mr. Bottomley have made careful measurements of the energy expended in the production of light in my lamps. Some of their results are shown in a table, from which it appears that with one of my small lamps, when rather less than one-sixth of a horse power was expended upon it a light of 42 candles was emitted, or an aggregate of 270 candles per horse-power. With a higher electro-motive force, and, therefore, a larger current, 102-candle light was obtained from the same lamp. This amount of light was produced by the expenditure of rather more than one-fourth of a horse power—that is, the horse-power under these conditions yielded 390 candles. By producing light in this manner, and employing the gas engine as the motor to drive the dynamo-electric machine, the very interesting result is arrived at that more light is obtained from a given quantity of gas exploded in the gas engine than can be obtained by burning the same quantity in the usual way to produce light directly.

An important point in this method of illumination—and one of particular interest to engineers—is the necessity for regularity of speed in the motor, unless some regulating device, such as a secondary battery, intervene between the dynamo-electric machine and the lamps. Without such assistance the slightest irregularity in the speed of the dynamo makes itself apparent in the fluctuation of the light. The light is so sensitive to variations of speed that the overlap of a driving belt is quite sufficient to make the light "wink" at every passage of the joint over the pulley. But I do not apprehend a continuance of this slight difficulty, for it is quite certain that the secondary battery, in which so great an improvement has recently been made by M. Faure—used in the manner described by Sir William Thomson on Friday last—will come into use to do away with it entirely; and at the same time supersede many other of the difficulties and inconveniences of supplying a current to lamps directly from the dynamo-electric machine. The extremely rapid alterations of direction which occur when incandescence lamps are lighted by alternating-current machines do not produce any unsteadiness of light. The lamps which have been kept lighted during several nights past in one of the picture galleries of the Exhibition here, and which some of you have probably seen, are worked by a Siemens' alternating current machine. You would notice they have been perfectly steady. It is a question which time alone can answer whether the lamps will prove more durable with an alternating or with a continuous current. There is, perhaps, some slight ground for surmise that they will last longer with the alternating current. Referring back for a moment to the use of my lamp in mines; so far the mine lamp, defended by a suitable lantern, has been attached by flexible conducting wires to main conductors. The limited portability this arrangement allows is inconvenient and the main conductors are expensive, and their retention does not permit the total elimination of the element of danger in connection with the accidental breakage of wires.

I have, therefore, thought that a completely self-contained and portable mining lamp would be an advantage, and I have here a specimen of such a lamp, for the construction of which I am indebted to the skill of Mr. Gimingham. This lamp can be kept lighted for six hours by two cells of Faure's secondary battery, weighing ten pounds, and will give the light of one or two candles in that time. To charge the battery afresh it will only be necessary to place it for a time in connection with a dynamo near the pit's mouth; the lamp and its attached battery need never come out of the pit.

Now that we can look to the method of electric lighting by incandescence as a perfectly-practicable method, and now that we have the means of combining the economy of the mechanical generation of electricity with the constancy and many conveniences of the voltaic accumulation, it is clear that the time is now ripe for the almost unlimited application of electric light to general purposes, and that engineers may with much advantage give their immediate attention to the many details which fall within their province in connection with the mechanical production and distribution of electricity on a large scale.

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

(*From our own Correspondent.*)

THE iron market is in a better position this week than last alike as to demand and prices. This was conclusive from the firm front manifested by vendors alike on 'Change in Birmingham this afternoon, and in Wolverhampton yesterday. Few finished ironmasters would book for forward at present prices, as they were mostly inclined to "hold" for the further rise which they confidently believe will be obtained between now and the quarterly meetings.

Sheet makers were again in the position to report most activity. Their works continue fully on, and new orders are arriving with freedom alike from the galvanisers and from merchants who do in Australian, Russian, and Indian business. Prices in this branch were very firm, and some makers asked an advance of 5s. per ton upon "singles," leaving them at £8 per ton. Doubles remained at £8 10s., and lattens at £9 15s. to £10.

Boiler plates were a shade firmer in sympathy with the advance this week in the North of England. Makers experienced rather less difficulty than last week in getting their prices £8 10s. and £9 10s., according to quality. The demand, however, was not much improved.

Marked bar makers were reported to be slowly regaining their position, since the competition from the producers of medium quality bars is less severe than of late. The marked bar makers are consequently obtaining their £7 10s. and £7 per ton with more ease than before. Consumers of common bars state that for prompt deliveries they have to give a substantial advance in price compared with recently. A 5s. rise is general, and it is even claimed that here and there a rise of 10s. is obtained. I know of instances in which offers at £6 per ton have this week been refused by bar makers, who a few weeks back accepted £5 15s.; and the report upon 'Change is that some such makers are getting £6 5s.

Hoops are worth more by 2s. 6d. per ton than a fortnight ago, and the instances are rarer than a week ago in which less than £6 10s. will be accepted. For hoops of guaranteed "cooper quality" 5s. per ton above the general market rates is asked by some producers. Merchants are again in the market offering hoop orders on United States account, but for forward delivery makers generally demand higher prices than the middlemen are at present prepared to give.

Thin sheets for deep stamping are in more active sale, and better prices are being obtained. Tin-plates—an industry which in this district runs very much hand in hand with thin sheets—are in large out-turn, but it is difficult to get better prices. Coke qualities were quoted this afternoon on the open market at 18s. to 19s., and charcoal qualities at 21s. to 22s. per box.

Pigs were very strong this afternoon as regards Derbyshire, Northampton, and Lincolnshire sorts. The prices of ten days or so ago would not now be accepted by vendors. A few agents of Derbyshire special brands quoted as much as 47s. 6d., but they could not by any means secure the price. Staffordshire part mines and common pigs were advanced 2s. 6d. per ton, making the former 52s. 6d. and the latter 42s. 6d. These were the prices of, for instance, the Spring Vale Iron Company. Their mine pigs remained at the old figure of £3. Hematites were very firm, and quotations ranged from 66s. up to as high as 70s. The high prices, however, checked buyers.

In the coal trade an advance is expected to be declared early next month of 1s. upon furnace and forge sorts and 6d. on slack. Best forge coals would then become 9s. and best furnace 10s. Cannock Chase house coal will, it is anticipated, be equally advanced.

The Parkfield Ironworks, Wolverhampton, has been sold for £20,000 to the Lydney and Wigpool Iron Ore Company, of the Forest of Dean.

Two of the chief proprietors in the Lydney Company are Mr. Fox, steel manufacturer, of Sheffield; and Mr. Bird, of London. The works have the advantage of possessing alike a railway siding and canal basin. They are said to have originally cost some £200,000, but considerable outlay will now be necessary before they can be got into full profitable work.

The heavy ironfounders have plenty to do on mill and forge work, and gas and water pipes. Constructive ironwork manufacturers are also tolerably busy on work for railways, bridges, and piers, and telegraph and other wire is just now being ordered in considerable quantities.

Most of the galvanised roofing manufacturers have a great deal of work in reserve, apart from some valuable orders that have just come in for cattle-feeding cribs, troughs, and other agriculturists' requisites. Small tanks and cisterns have also a good sale at the same works.

Safe and strong-room manufacturers are busy in filling orders, mainly for Australia, India, and South America. I have this week inspected a particularly noteworthy production in this line at the Cleveland Safe Works, Wolverhampton, of Mr. George Price. It is a strong-room intended to be built into masonry in Manilla, the Capital of the Phillipine Islands. The design is that of an engineer out there, who is desirous of supplying a banking company with a room that shall resist the crushing strains of the earth shocks with which the place is occasionally visited. The weight is over 4 tons; the dimensions, 7ft. 6in. deep × 6ft. × 5ft., and the roof is arched. Bessemer steel plates of $\frac{5}{8}$in. thickness obtained from Sheffield are used throughout in its construction, fastened together by means of angle, tee, and channel sections of iron, secured with rivets and screw bolts of steel. The interior is strengthened by a tee iron rib, which, springing from the centre, traverses the sides and roof. The door is secured by eight large bolts under the control of a tee handle, and kept in place by the firm's patent *ne plus ultra* 9-levered lock. A fire-resisting chamber of $4\frac{1}{2}$in. is affixed to the inside of the door, and around the sides and top of the door there are similar chambers of 6in. dimensions. To allow of the door being left open in the day, a ventilating grill gate is provided, the frame of which is of tee iron, and the top of which is arched to correspond with the strong-room.

The members of the wrought iron tube trade who, by the alteration of the discounts recorded last week, have advanced the price of some descriptions as much as 15 per cent. on the net, will have to be careful that their action does not lead to foreign competition. The new list of prices will assuredly give the foreigners more chance; and it must be borne in mind that already German made tubes are now being sold even so near the centre of the industry as Birmingham.

As to export business in hardwares, manufacturers communicate with much satisfaction that recent telegraphic despatches from New South Wales are more reassuring, and that prices are recovering a little out there. New Zealand is buying well, but the great Eastern markets are less active than is usual, and South America is, too, at the moment quieter. Larger orders have come in from several of the markets on the Mediterranean, and both German and Belgian demands are improving. Goods required for shipment to the northern European ports are ordered rather briskly, and quick delivery pressed for, so that they may reach their destination before the close of the navigation season.

The War-office authorities at Woolwich are likely to place in this district, as the result of tenders recently submitted, orders for extensive supplies of saddlers' ironmongery.

The agitation in the nut and bolt trade, to which reference was made in my last report, has resulted in the men employed in Darlaston coming out on strike for higher wages.

Manufacturers engaged in the silver-plating trades should derive benefit from a new material for spoons and forks, which has just been brought out by Mr. A. Browett, of Dean-street, Birmingham. Siderophon, or "Heart of Iron" as the material is called, consists of tempered steel blanks, thickly cased with molten Britannia metal, and finally electro-silver plated. Great strength and lightness are thus attained, while the articles have the lustre and ring of silver, at the price of the commonest white metal goods.

This week there is being held in the Exchange Hall, at Wolverhampton, an exhibition of domestic and sanitary appliances, in which between fifty and sixty exhibitors from various parts of the kingdom are taking part.

The Walsall Chamber of Commerce has since my last report been formally constituted. At the inauguration of the new Corporation, the mayor presided over an influential representative assembly, over eighty firms having already consented to join.

The governing authorities of Sedgeley, South Staffordshire, have determined upon the erection of a gasworks if they can obtain parliamentary sanction to the scheme. They are now looking out for a suitable site.

The North Staffordshire ironworkers are agitating for an increase of 10 per cent. in their wages, and with the object of securing such an advance the leaders are urging upon the men the necessity of immediate combination.

NOTES FROM LANCASHIRE

(*From our own Correspondent.*)

Manchester.—It is difficult to form any very sound judgment as to the actual state of the iron trade of this district just at present. The upward movement at Glasgow and Middlesbrough has caused an unsettled feeling here, and there was rather an excited market at Manchester on Tuesday, but there is no large amount of buying going on. The bulk of the business has, in fact, already been done, so far as the remainder of this year is concerned; the deliveries which producers have to make will keep them tolerably well employed for the next three months, and the principal consumers have for the most part fully covered their requirements for a similar period. Any business which can now come into the market, except for long forward delivery, which there is not much disposition to entertain, is consequently confined to limited proportions, and the advance in prices now being asked is only being realised on comparatively small sales. Where makers are asked for quotations they are, however, very firm in holding out for advanced prices, and buyers who are compelled to come into the market have to pay more money, but merchants show a disposition to enter into "bear" operations, and both pig and manufactured iron is being offered at under makers' present quotations.

The firmer tone shown by makers has, however, to some extent tended to bring more orders into the market, and during the past week there has been, taking all things into consideration, a fair amount of business doing. Lancashire makers of pig iron have been doing tolerably well, being now fairly sold for the remainder of the year, they have advanced their quotations nominally to the extent of 2s. 6d. per ton. There has, however, been very little doing at the advanced rates, and the actual prices realised have not been more than 1s. to 1s. 6d. per ton above late rates, the real market price of Lancashire pig iron delivered equal to Manchester being now about 45s. up to 46s. and 46s. 6d. per ton, less $2\frac{1}{2}$ per cent. for forge and foundry qualities.

In outside brands of pig iron there has also been more doing, and better prices have been obtained. Sales of Lancashire pig iron have been made at 45s. 6d. to 46s. 6d. per ton, less $2\frac{1}{2}$ delivered here. Middlesbrough iron has been sold at about 47s. 6d. net cash; and a fair amount of business has been done in Scotch iron at about 57s 6d. per ton net cash delivered equal to Manchester.

Finished iron makers, who continue very busy, have, of course, followed the upward movement in pig iron, and advances of 2s. 6d. to 5s. per ton upon late rates have been asked. Buyers do not readily respond to this advance, but makers are now holding out for £6 5s. for bars delivered into the Manchester district, and this figure is only being quoted for immediate speculation.

Toolmakers throughout Lancashire continue well employed, and I hear of American orders coming into this district.

Although there is not the same amount of activity in the general engineering and machine-making branches of trade, most of the large firms in the immediate neighbourhood of Manchester appear, for the present at least, to be fairly supplied with orders, and the monthly returns issued by the Amalgamated Society of Engineers show a continued steady decrease in the number of men out of employment. From all the Manchester districts trade is reported as moderately good, and similar returns are made for Oldham, whilst Barrow-in-Furness is reported as good, Birkenhead, Accrington, Bacup, Chowbent, Chorley, Darwen, and Lancaster are reported as moderate, but Liverpool now figures as moderate, declining, and bad, and Bolton, another important district, is in the same position, whilst Ashton, Blackburn, Burnley, Garston, Heywood, Rochdale, St. Helen's, Staleybridge, Widnes, and Wigan are all returned as bad, with in some cases hands being discharged. Taking the returns for the whole kingdom there is a decrease of eighty in the number of the society's members on donation, or, in other words, out of employment; but this to a large extent is due to the activity in the Scotch shipbuilding yards.

The agitation with regard to an advance, or as the men put it for a return to the rate of wages ruling three years ago, which was commenced a few weeks back, seems for the present to be held in abeyance. On the one hand the masters have not seen their way to give any higher wages just now, and the men on the other hand have felt that they would not be justified in attempting to force an advance by a stoppage of work.

During the past week there has been a very general stoppage of the cotton spinning mills, with the object of breaking down the corner in the Liverpool cotton market, but in the weaving department the movement so far has only been partially followed. So far as machinists and millwrights are concerned the closing of the mills has tended rather to make them busier, as advantage has been taken of the stoppage to carry out any necessary repairs.

The necessity for some automatic apparatus for registering the periodical revolutions of ventilating fans, and the fluctuations in the air pressure created for ventilating mines, has frequently been brought into prominence during the course of the inquiries which have of late been made with reference to coalmine explosions, and the importance of this question has also been forcibly set forth in the official repor hich have been made to Government by Mr. Joseph Dickinson, H.M. Chief Inspector of Mines. As the result of the suggestions which have been thrown out by Mr. Dickinson, an automatic mine ventilator recording apparatus, designed by Messrs. W. H. Bailey and Co., of Salford, has, within the last few weeks, been fitted up at Messrs. Brooke and Pickups' Townley Collieries, Burnley. The instrument is in itself a modification of the automatic clock recording arrangement which Messrs. Bailey have already applied to a variety of purposes, and it may be briefly described as follows:—A mahogany case, standing 8ft. high, encloses a strong eight days clock, which also drives a drum carrying on its face a removable diagram paper. The drum makes one revolution per week, and the diagram is divided into columns for each day, with further sub-divisions for the hours and half hours. Below this diagram is a counter dial up to one hundred millions, and beneath the counter there is contained within the case a copper float and a syphon cistern. These practically embrace the whole of the working parts, and the apparatus is coupled up to a Guibal fan or other system of ventilation as follows:—A small shaft in connection with the speed indicator is attached to the engine which drives the fan, and for every thousand revolutions made by the engine a mark is struck by a pricker upon the drum diagram. By this means a record is obtained of the speed at which the engine has been working, and by simply counting the marks upon the diagram the number of revolutions made by the engine during any half-hour, hour, or day, at any period during the week, can be ascertained, whilst the total number of revolutions is indicated on the counter dial below. For the purpose of obtaining a record of the fluctuations of the air pressure, a $\frac{1}{4}$in. tube is attached to a cock in the lower portion of the case, and this tube is brought into connection with the fan. According to the pressure obtained through this tube upon a column of water contained within the lower part of the case, a pencil marks upon the drum diagram the varying differences in the air pressure created by the fan, whilst the speed at which the engine has been working is also recorded upon the same paper.

In the coal trade a brisk demand is maintained for house-fire classes of fuel, and there is a strong tendency towards a general advance in list rates at the close of the month. In other classes of fuel, however, the demand still shows no improvement, and engine fuel, if anything, is more difficult to move, owing to the stoppage of many of the Lancashire mills and the increased quantity of stock now being produced. The average prices at the pit's mouth are about as under:—Best coal, 8s. 6d.; seconds, 6s. 6d. to 7s.; common coal, 5s. to 5s. 6d.; burgy, 4s. to 4s. 6d.; and slack, 3s. to 3s. 6d. per ton.

The Lancashire colliers seem determined to go in for an advance of wages, and if colliery proprietors can see their way to maintaining a slight advance in prices, there is little doubt they will be prepared to concede something to the men rather than encounter another strike like that of last winter.

Barrow.—The hematite pig iron trade, which has shown a steady improvement, has this week still further strengthened its position. The demand is better than it has been for some time. The gradual growth of the demand gives an exceedingly healthy tone to the market, inasmuch as there has been no rapid movement, but a slow and steady progression, without any of the unhealthy vigour about it which has a tendency to rush up prices too suddenly. At present values are going up very steadily, and I think the demand is likely to be well maintained for some time to come, and better prices are likely to be realised. The tonnage of metal which has to be made to the United States during the current year is very heavy, and as the demand from America is well maintained, makers are likely to be kept fully employed. The continental demand is very good. The inquiries which have come to hand, and are still being made, have placed some makers in the position of not being able to complete deliveries this season. This week's quotations for No. 1 Bessemer is 61s. per ton at works; No. 2, 59s. 6d.; No. 3, 58s. No. 3 forge is changing hands at about 58s. In the steel trade a very good business is being done. The demand for steel rails is very brisk, and I know very fair orders have been booked for blooms and other descriptions. The market all round is very good; plates, tram sections, and merchant qualities are in good sale. Billets and wire are heavily sold forward. I find that this increased demand has made an appreciable reduction in the stocks of both iron and steel

Iron shipbuilders are well employed, and their hands will be full for some time to come, while there are rumours of other large orders being shortly forthcoming. Engineers, ironfounders, and other industries are well employed. The demand for iron ore is better, and raisers are firmer in their prices. At some of the pits they are largely sold forward for some time to come.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE inquiry for house coal continues to be brisker, the demand for "stocking purposes" having set in already for the London market. This is about three weeks earlier than last year. At London the merchants are reported to have made an advance of 1s. 6d. per ton in the price of house coal. This rise cannot be on account of any increase in the prices of South Yorkshire and North Derbyshire coal, as the winter advances have not yet commenced. At Manchester the Lancashire coal has been increased by 6d. per ton. No change in prices is expected in the Sheffield district until the 1st of October.

The iron market has also been firmer, and prices may be said to have stiffened. It is said that the firmness in the iron market is caused by the renewal of negotiations between the Glasgow and Cleveland ironmasters for restricting production 20 per cent. There is no doubt, however, that an equally important cause is the increased shipment to foreign markets, and a better state of trade at home.

In the heavy branches there is continued activity in all departments. One large house in the steel rail trade is increasing its means of production, which is a somewhat significant incident in view of the general complaint as to railway rates necessitating the transfer of the heavy trades to the coast. One local firm of rail makers have orders on their books sufficient to last them until next March. Another firm are sending to America at the rate of 2000 tons per week, and the inquiry, both on American, colonial, and home account, does not seem to abate. There is no doubt that rails at an average rate of £5 12s. 6d. per ton are about as low as they can be—though they have touched lower quotations since the famine years of 1873-4—and the railway companies who are now taking advantage of the present rate to relay their ways are unquestionably adopting a prudent course.

Nothing further has transpired in reference to the proposed removal of the Dronfield Steel Works to Workington. The negotiations, I understand, are still in progress, and there is every prospect that they will be brought to a conclusion. I believe there is not the slightest doubt that Messrs. Wilson, Cammell, and Co. will this time finally resolve to transfer their business to the Cumberland coast. I was informed the other day that they had given heavy orders for castings to be delivered at Workington. This would have indicated that they contemplated an almost immediate removal of their business. On inquiry, however, I ascertained that the statement as to the castings was not correct.

In the lighter branches of Sheffield trade I begin to hear rather better accounts. There has been a favourable change in the weather, and it is remarkable how quickly this tells upon the home demand for light goods. The file and edge tool branches are fairly well employed on foreign and colonial account, and even the saw trade, which is usually about the last to move, cannot be in an unfavourable state, the saw grinders reporting that they have no hands "on the box." This means that the Saw Grinders' Union is not called upon to support any of the workmen, in consequence of their having full employment. The cutlery manufacturers are doing a capital business for distant markets, and a noticeable feature is an important call for all kinds of cutlery goods for Ireland. Razor manufacturers have more orders in hand than they can get out in the time specified. One or two of the silver-plate manufacturers report an improved demand, but they state that the bad weather has very seriously affected the summer trade.

There is a noticeable change for the better in the Russian market, an abundant harvest has been obtained there, and the effect will no doubt promptly tell in the revival of business with Russian merchants. With Germany and with other continental markets there is an average trade doing, but the French business is a good deal harassed by the prospect of a new tariff, of the probable effects of which on light goods I gave you particulars last week.

The report of the Sheepbridge Coal and Iron Company, Limited, shows a gross trade profit for the year ending June last of £31,192 3s. 5d., reduced by interest on loans and other preference charges to the sum of £7719 14s. 10d., added to the balance of £6700 of the preceding year, and deducting £565 from dividend on the "C" guaranteed preference shares, the sum available for dividend is £13,854 16s. 10d. The directors recommend a dividend of 2 per cent., disposing of £8970, and leaving £4884 to be carried forward. The report further stated that the iron trade continued throughout the company's business year in the same depressed condition to which it had fallen at the period of the issue of the last report. A more cheerful feeling, accompanied by an increased demand and slightly enhanced prices, manifested itself in July last, but the untoward change in the harvest prospects, together with the disturbances in the money market, had for the present checked this upward movement. The strike in Lancashire in the early months, and the prevalence of severe weather, created a large temporary demand of both house and manufacturing coal, and for about three months the coal trade was profitable. Unfortunately, the two house coal collieries belonging to the company were flooded during a considerable portion of the time.

The interim dividend of 5 per cent. of Wm. Jessop and Sons, Limited, is payable on the 1st October.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE pig iron market held at Middlesbrough on Tuesday was extremely animated. Buyers, whether consumers or merchants, had evidently become frightened, and bought greedily, and in large quantities. Prices were 1s. higher than they were a week previously, and 3s. 3d. higher than at the beginning of the month. Much discussion took place as to the conference at Carlisle the day before between representative ironmasters from Cleveland and from Glasgow. The general impression was that difficulties would be found when the attempt was made to carry out the recommendation to reduce the output by 12½ per cent. It is understood that in Cleveland it is not intended to put any furnaces absolutely out of blast, except one or two which need to be re-lined. The curtailment of production is to be effected by merely slackening the blast, and the question has been asked, whether this may not easily be evaded. However that may be, it is clear that the average opinion is that some restriction of production will be carried out; and in view thereof, buyers wish to make themselves secure of supplies before the scarcity is really felt. No. 3 G.M.B. was on Tuesday sold at 40s. per ton, f.o.b., and No. 4 forge at 39s. Connal's warrants were to be had for 40s. 6d. It is not thought that in any case pig iron will rise very much above present prices, because of the heavy stocks now in hand. In all probability warrant holders will attempt to realise as soon as they think the highest point is reached, and this, if done extensively, would at once lead to a reaction. Connal's Middlesbrough stock has increased 170 tons since Tuesday last, and stands to-day at 186,497 tons. The manufactured iron trade has improved in sympathy with pig iron; but scarcely more than enough to cover the enhanced cost in respect of that material alone.

It is not true that the plate makers have officially advanced their minimum price by 5s. per ton, as was announced in the local papers. On the other hand it still remains at £6. But there is no doubt but that it would not now be possible to buy except at an advance of 2s. 6d. to 5s. per ton. Indeed, the latter price has been paid repeatedly.

During last week ship and bridge builders took something like a panic at the rise in pig iron, and bought plates and angles very freely. The contracts made were sufficient to supply the whole district with work for four or five weeks ahead. Bars and angles are fetch £5 15s. per ton.

Coal remains steady at previous prices. Coalowners are hoping in some way or other to get a share of the advance in prices. But consumers argue that if the furnaces go out, less coke and less coal will be used, and consequently the price of the latter should be easier.

It is announced that two young men have bought the rolling mills formerly belonging to the West Hartlepool Iron Company, and are about to set them to work. They have no doubt obtained them at a low price, but, inasmuch as the works have been idle for many years, it is possible that the machinery, and especially the boilers, will be in a very bad state of repair. Judging by the experience of the Skerne Iron Company, the Bishop Auckland Ironworks, and the Wear Rolling Mills Company, this new venture would not appear likely to be a very promising one; but it is impossible to say what may not be done in cases where large works are obtained for an old song, provided they are well situated.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE iron market has been greatly excited in the course of the week, on account of the proposal of the ironmasters to damp out a proportion of the blast furnaces. In the early part of the week doubts were freely expressed as to whether the damping out process would really be resorted to. There were some who were of opinion that the Cleveland and Scotch ironmasters could not possibly arrive at such an agreement as that proposed; and it was upon the strength of such opinions as these, and their opposites that the prices in the warrant market fluctuated almost daily. The upward movement has, on the whole, however, been maintained, and the quotations have gained about 3s. on the week. Almost every day a large business has been done in warrants, the transactions being on a much more extensive scale than has been experienced for a long time. Deputations of the Scotch and Cleveland ironmasters met at Carlisle on Monday afternoon. The proceedings are said to have been of the most amicable nature, and it was "agreed that each district be recommended to reduce the make of pig iron by 12½ per cent. for a period of six months." It will be recollected that 2s. per cwt. was the amount first mentioned by the Scotch masters, but it was understood that this would be liable to modification. There are several Scotch firms, I believe, that will not take part in the reduction, but the majority of them are quite in earnest on the subject. At the same time a variety of circumstances may occur to modify the agreement, even after it shall have been formally signed. The effect in Scotland will be to curtail the output by about 2600 tons per week, which will greatly relieve the market, and should the present good shipments continue, almost, if not altogether, wipe off the quantity of pig iron that is being added to stock.

The course of the warrant market has been as follows:—On Friday the market was irregular but strong, with a large business at from 49s. 1½d. to 49s. 8½d. The market opened on Monday at 50s. cash, but became weaker, receding to 49s. 6½d., and closing at 49s. 7d. Business begun on Tuesday at 50s. 3d., but receded to 49s. 11d. Yesterday, irregular market, opening 51s. 3d. to 50s. 10d. month, and 51s. to 50s. 9d. cash, closing at 49s. 10d. cash and 49s. 11d. month. To-day—Thursday—fair business at 51s. 1d. to 50s. 8d. cash, 50s. 3d. to 50s. 10d. month, closing sellers, 50s. 6d.; buyers 1d. less.

The prices of makers' iron, which are all advanced in sympathy with warrants, are as follows:—G.M.B., f.o.b. at Glasgow, No. 1, 50s.; No. 3, 47s.; Gartsherrie, 57s. 6d. and 51s. 6d.; Coltness, 58s. 6d. and 51s. 6d.; Summerlee, 57s. 6d. and 49s.; Langloan, 58s. 6d. and 51s. 6d.; Carnbroe, 53s. and 48s. 6d.; Calder, 58s. 6d. and 50s.; Clyde, 51s. 6d. and 47s. 6d.; Glengarnock, at Ardrossan, 51s. 6d. and 48s.; Eglinton, 50s. 6d. and 46s. 6d.; Dalmellington, 50s. 6d. and 47s. 6d.; Shotts, at Leith, 58s. 6d. and 50s. 6d.; Kinneil, at Bo'ness, 50s. and 48s.; Carron, at Grangemouth, 57s. 6d. and 48s. 6d.

Indications of prosperity in the malleable iron trade are visible on all hands. Most of the works in Lanarkshire are exceedingly busy, and in some cases large additions are being made to plant in order to meet the contracts now in hand. There is, as a rule, no change in the prices of malleable iron; but if the ironmasters should put out furnaces for any length of time, it is probable that values may advance.

The coal trade continues in that active state which has marked it for a number of weeks past. The inland demand is rather better than usual at this season; a large consumption of coals takes place at the ironworks and factories, and the shipping demand has been very good. There is little or no alteration in prices.

Great efforts have been made for some time by the promoters of the Miners' Association in the West of Scotland to recruit its ranks, and bring about a movement for an advance of wages. Up to about a week ago the leaders of the men were divided among themselves, but a reconciliation was then effected, and a meeting was called at which delegates said to represent 9000 men were present. Mr. Macdonald, M.P., was in attendance, and made a speech in support of a motion to the effect that the time is now arrived when the miners of Scotland can reasonably ask for an advance of 6d. per day on their wages. He reviewed the course of similar movements in the past, showing that when the miners restricted their labour too much outsiders were brought into the mines, and very soon crowded the market with coals. The colliers were also warned by the hon. gentleman not to make an exorbitant demand upon their employers, as they had done a year ago, because by this means trade was driven from the country, and the masters had greatly to reduce the price of coal to bring it back. He quoted the prices obtained for coals throughout the mining districts of England and Scotland, to show that the Scottish coal masters were charging on an average 2s. less per ton than was got elsewhere. Mr. Macdonald pointed out that if the ironmasters damped down 20 per cent. of their furnaces, this would release coals to that amount to be thrown upon the market, and render it the more difficult for the colliers to obtain an advance. To counteract this, he recommended the colliers to restrict their output of coals to three tons per man daily all over, and they would be successful. Among the other speakers at the meeting was Mr. Lloyd Jones. Deputies were appointed to wait upon the masters and ask the advance, and this they did in the course of the week. It may be added that the sale coalmasters are understood to be willing to give the men a little more wages; but their ability to grant a permanent increase will depend upon the supply of coals in the market.

The miners of Fife and Clackmannan have also approached their employers for an advance of 6d. per day.

At a meeting held at Hamilton a few evenings ago, the Mining Institute of Scotland—Mr. Ralph Moore president—had an interesting discussion with regard to the success of the electric light in Mr. Watson's Earnock Colliery. It was stated that the miners preferred the old lamps to the electric light, although they admitted it gave a superior light to the ordinary safety lamp. In reference to the experiment of breaking a lamp in the midst of inflammable gas to ascertain whether it would be exploded by it, it appeared that a representative of Mr. Swan had stated that he did not consider the test a fair one, and that had the little Swan lamp been enclosed in a protecting lantern there would have been no explosion, because the blow that would break the lamp would also break the carbon filament, and it would not be possible to ignite the gas. Mr. Gilchrist, the secretary, said that he was inclined to think this was really the case. A committee was appointed to consider the whole question of electric lighting in collieries, and report to a future meeting.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

I AM glad to report Mr. Menelaus as improving, and the strong possibility that he will again be enabled to continue in full management at Dowlais.

I see that Rhymney is making good headway. The make of iron will be discontinued there in another week or two, and all energy be concentrated on steel. Two fresh mills are in progress, and one of these will be devoted to ingots for the American market. The lessened tariff on ingots, as compared with rails, is prompting this step, and the ingots cut into certain lengths will be such as to secure ready demand in the States. The new range of coke ovens by the Coppee Company is going on well, and is now in active course of erection at Rhymney; so prospects look bright in that quarter.

I am glad to announce the signing of Articles of Association for the new wire work industry at Merthyr. The improvement in price—10s. per ton during last week—comes at the right time for a start.

The steel trade generally is looking up. Good cargoes are going to America. The total from Wales last week of iron and steel amounted to 3600 tons.

Pig iron is looking up, and higher prices were obtained at Newport last week. Bars remain at £5 5s. to £5 10s.; iron rails, £5 10s. to £5 12s. 6d.

Tin-plate is still flagging, and the last little spurt has disappeared again. An official report gives the following list of works that are now in more or less active condition:—In Carmarthen and Glamorgan, 44; Monmouth and Gloucester, 22; Stafford and Worcester, 11; Mold, 1; Workington, 1; Motherwell, 1. Total make of last year, four millions and a-half of boxes. Out of this make fully half is exported, Swansea and Cardiff shipping large quantities.

The coal trade of Wales continues satisfactory, and large contracts have been completed at 11s., best steam f.o.b., at distant periods.

Messrs. Nixon, Taylor, and Company and Powells Duffryn have the credit of taking the Pacific Company's contract for 1882. Leading authorities in the coal trade regard present indications as eminently favourable. The house coal trade, for instance, is very firm and healthy, and buyers are giving way more freely to the higher quotations which prevail. A tolerable approximation to old averages exists in prevailing totals. Last week the foreign coal shipments from Wales were not much under 150,000 tons, of which Cardiff sent 107,288 tons.

The annals of colliery explosions stood a close chance a few days ago of having an important addition. At Pentre, a colliery in the Rhondda, once the scene of a great loss of life, a fire broke out when over 400 colliers were busy at work. Thanks, however, to daring efforts on the part of the fireman, and the men having a way of escape, nothing very serious occurred. Mr. W. Thomas Brynawel is the mining engineer of the colliery, and the name is a guarantee both for capacity in carrying on such a colliery, and for personal self-sacrifice in the event of these calamities happening. "Happen they will," said an eminent authority lately "in all these gas producing collieries."

The coal and iron trades in the Cinderford district are improving.

The greatest activity continues at the new docks, Swansea. Two men were killed there on Tuesday.

Two small strikes have occurred in the Swansea coal district—very local in character—and one has been settled this week at Bryndewi by the return of the men at old rates.

I suppose a vacancy will occur at Dowlais Collieries; Mr. Truran, the manager, retires after long and successful service. The only failure has been in respect of Bedlinog, but here no one could have anticipated such broken ground.

AMERICAN PORTABLE ENGINES.—The following from the *American Manufacturer* does not convey a very favourable idea of American portable engines:—"Explosions of steamboat boilers used to be the fashion, but in recent years explosions of thrashing machine boilers are 'the thing.' Is there no remedy?"

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 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.

13th September, 1881.

3949. OILING APPARATUS, W. Currie, Belfast.
3950. HEELS, W. Morgan-Brown.—(*J. Brooks, Boston, U.S.*)
3951. FURNACES, S. Pope, Newburn.
3952. LIFEBOATS, J. Wetter.—(*G. Berrell, Pennsylvania.*)
3953. CAPSTANS, J. Wetter.—(*C. Arentsen, Norway.*)
3954. COUPEINGS, A. Thomson, Southampton.
3955. OIL LAMPS, &c., J. Whitehead, Southport.
3956. PLATES and BARS, J. Larue, Paris.
3957. GAS REGULATORS, W. T. Sugg, Westminster.
3958. STARCH SUGAR, P. Jensen.—(*F. Soxhlet, Germany.*)
3959. STARCH SUGAR, P. Jensen.—(*F. Soxhlet, Germany.*)
3960. PIANOS, F. Wirth.—(*G. Philipp, Germany.*)

14th September, 1881.

3961. DRAINAGE, R. H. Reeves, Isle of Wight.
3962. OPEN FABRICS, T. Coltman, Leicester.
3963. CHECKING, W. Riddell and H. Wickens, London.
3964. NEEDLES, T. Perks.—(*R. Crowley, New York, U.S.*)
3965. LAMP BURNERS, J. S. Fairfax.—(*W. Painter, U.S.*)
3996. GAS APPARATUS, P. Justice.—(*A. Clavel, Belgium.*)
3967. LAMPS, &c., J. G. Ellis, London.
3968. HEATING WATER, F. T. Bond, Gloucester.
3969. ENGINES, H. Muir and J. Caldwell, Glasgow.
3970. PERAMBULATORS, G. Asher, Birmingham.
3971. SECURING HORSES, J. C. Mewburn.—(*J. Daviau, France.*)
3972. STOVES, S. C. Davidson, Belfast.
3973. LAMPS, J. Wetter.—(*H. Naumann, Leipzig.*)
3974. FURNACES, J. Wetter.—(*G. Permet, France.*)
3975. LAYING ELECTRIC WIRES, J. W. Smith, Edinburgh.
3976. ARC LAMPS, P. Jensen.—(*A. Cance, Paris.*)

15th September, 1881.

3977. SEWING MACHINES, A. Boult.—(*J. Jarlan, France.*)
3978. CHURN, W. Rainbow, Luton.
3979. COVERING TRAM-CARS, &c., E. H. Grey, London.
3980. PARLOUR GAME, J. Maxfield, London.
3981. ABDOMINAL, &c., BELTS, H. Willington, London.
3982. FASTENINGS, H. Lake.—(*C. F. Littlejohn and H. Ford, U.S.*)
3983. PISTONS, F. Engel.—(*C. A. Zirn, Hamburg.*)
3984. PITCH CHAINS, A. H. Wallis, Basingstoke.
3985. DOOR KNOBS, H. Lake.—(*C. C. Harrington, U.S.*)
3986. SAFETY DEVICES, A. H. Turner, London.
3987. SECONDARY BATTERIES, J. S. Sellon, London.
3988. COLOURING MATTER, F. Wirth.—(*Messrs. Kalle and Company, Germany.*)
3989. COLD AIR MACHINES, E. Hesketh, Dartford.
3990. FIRE EXTINGUISHING APPARATUS, A. M. Clark.—(*P. Oriolle, France.*)

16th September, 1881.

3991. PREVENTING DETERIORATION, J. Baker, London.
3992. BEETLING MACHINES, C. Edmeston, Salford, and S. Smith, Manchester.
3993. HEATING WATER, W. Wyman, Gloucester.
3994. LUBRICATORS, H. F. Lawrence and H. Stokes, Birmingham.
3995. TRANSPORTING, &c., FRUITS, H. A. Bonneville.—(*D. Cornilliac, Paris.*)
3996. TWISTING COTTON, &c., A. Yates, Derby.
3997. CONTROLLING WIRE-ROPES, H. Cheesman, Hartlepool.
3998. KNIFE HANDLES, &c., G. Renton, Sheffield.
3999. MEAT EXTRACT, L. Groth.—(*H. Bloch, Denmark.*)
4000. PERMANENT WAY, T. Bunning, Newcastle-on-Tyne.
4001. BATHS, &c., J. Shanks, Barrhead.
4002. CAST IRON, H. J. Haddan.—(*J. Chaine, France.*)
4003. IRON, &c., WHEELS, W. Somers, Halesowen.
4004. CASES, W. R. Lake.—(*C. W. Livermore, U.S.*)
4005. STORING ELECTRICITY, J. S. Sellon, London.
4006. SAWING, &c., F. Myers, New York, U.S.

17th September, 1881.

4007. CARRYING, &c., LIQUIDS, G. White, Wilden.
4008. BORING APPARATUS, M. Macdermott, London, and W. Glover, Bermondsey.
4009. SCREW PROPELLERS, R. M. Steele, Hampstead.
4010. COOKING STOVES, J. Imray.—(*La Société des Specialités Mecaniques reunies, Paris.*)
4011. ELECTRIC LAMPS, B. Hunt.—(*A. E. Brown, U.S.*)
4012. PULLEY BLOCKS, T. Ward & E. Howl, Tipton.
4013. CIGARETTES, D. Nicoll, London.
4014. MOUNTING COTTON, H. Greg, Bolton.
4015. VELVETS, W. Mather, Manchester.
4016. KNIVES, W. A. Barlow.—(*Messrs. Bierhoff and Wever, Germany.*)
4017. ELECTRIC LAMPS. S. Hallett, London.
4018. SHADING DEVICES, F. Wirth.—(*A. Gruis, Germany.*)
4019. ELECTRICITY, G. E. Dering, Welwyn.

19th September, 1881.

4020. CONSUMING SMOKE, G. West, Nottingham.
4021. LAMPS, T. Ward, London.
4022. TORPEDO BOATS, A. F. Yarrow, Poplar.
4023. STITCHING SEAMS, R. H. Brandon.—(*The Morley Sewing Machine Company, Holyoke, U.S.*)
4024. LAMPS, W. Morgan-Brown.—(*E. M. Fox, U.S.*)
4025. VELVET, R. S. and E. Collinge, Oldham.
4026. DYNAMO-ELECTRIC MACHINES, E. de Pass.—(*La Société anonyme des Câbles électriques, système Berthoud Borel, et Compagnie, Paris.*)
4027. CIGARETTES, M. Appelbaum, London.
4028. WATCH PROTECTORS, F. Wirth.—(*G. Speckhart, Germany.*)
4029. TELEPHONE TRANSMITTER, S. Pitt.—(*H. Machalski, Austria.*)
4030. LIFTING JACKS, F. H. F. Engel.—(*J. F. W. Schultze, Hamburg.*)
4031. SKEIN HOLDER, F. F. née Lecocq, Belgium.
4032. SEWING MACHINES, C. A. Snow.—(*F. G. Altman and F. Pommer, Edina, U.S.*)
4033. FLUSH CISTERNS, W. Wright, Plymouth.
4034. DYNAMO-ELECTRIC MACHINES, P. Jensen.—(*T. A. Edison, Menlo Park, U.S.*)
4035. GLUE, G. W. Bremner, London.
4036. CIGAR LIGHTERS, W. Clark.—(*C. H. Vibbard, Aurora, and J. D. Brooks, Albany, U.S.*)
4037. BATTERIES, W. Clark.—(*N. de Kabath, Paris.*)
4038. EXPRESSING JUICE, W. Thomson and J. Mylne, London, and J. B. Alliott, Nottingham.
4039. CORSETS, H. E. Newton.—(*M. Cohn, New York.*)
4040. BOOTS, H. Loads and F. Afford, Norwich.
4041. GLASS BOTTLES, H. Codd, London.
4042. GAS STOVES, S. Clark, London.
4043. CANS, H. H. Lake.—(*F. Fleischmann, Austria.*)

Inventions Protected for Six Months on deposit of Complete Specifications.

3943. PNEUMATIC ACCUMULATOR, J. Wetter, New Wandsworth, London.—A communication from M. Scharfberg, Lemberg.—*12th September*, 1881.
3985. DOOR KNOBS, H. H. Lake, Southampton-buildings, London.—A communication from C. C. Harrington, Newton, U.S.—*15th September*, 1881.
3995. TRANSPORTING, &c., FRUITS, H. A. Bonneville, Cannon-street, London.—A communication from D. Cornilliac, Rue Condorcet, Paris.—*16th September*, 1881.

3998. Handles for Knives, &c., G. Renton, Carver-street, Sheffield.—16th September, 1881.
4004. Cases, &c., for Lead Pencils, W. R. Lake, Southampton-buildings, London.—A communication from C. W. Livermore, Providence, U.S.—16th September, 1881.

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

3735. Preparing Wool, P. Kelly, Crosshills, Yorkshire.—21st September, 1878.
3854. Harvesting Machines, B. Samuelson and W. G. Manwaring, Banbury.—30th September, 1878.
4044. Cakes, T. D. Pruday, Birmingham.—12th October, 1878.
3637. Floating Pontoon Docks, R. Turnbull, South Shields.—14th September, 1878.
3660. Cutting Apparatus, W. Wright, Droylsden, and T. Bintliff, Manchester.—17th September, 1878.
3673. Steel Wire Cards, W. F. Bateman, Low Moor, Yorkshire.—17th September, 1878.
3719. Anti-fouling Composition, A. McMillan, Hill-head, Glasgow.—20th September, 1878.
3975. Furnaces, S. G. Thomas, Battersea Park, London.—9th October, 1878.
4063. Steel and Iron, S. G. Thomas, Battersea Park, London.—14th October, 1878.
3647. Transmitters for Telephones, H. Hunnings, Bolton Percy, Yorkshire.—16th September, 1878.
3692. Railway Crossings, W. R. Lake, Southampton-buildings, London.—18th September, 1878.
3738. Ships' Compasses, C. D. Abel, Southampton-buildings, London.—21st September, 1878.
4033. Dismembrators, C. Pieper, Berlin.—12th October, 1878.
3701. Obtaining Sulphuric Acid, J. Mactear, Glasgow.—19th September, 1878.
3730. Washing Apparatus, J. F. C. Farquhar and J. B. Macfarlane, London.—20th September, 1878.
4010. Paint Brushes, G. Russum, Leeds.—10th October, 1878.
4091. Raising Sunken Vessels, J. A. Westermann, London.—15th October, 1878.
3639. Gas-burner Regulators, G. J. Parkinson, Balsall Heath, Birmingham.—16th September, 1878.
3658. Magneto-electric Machines, J. H. Johnson, London.—17th September, 1878.
3850. Tempering Articles of Metal, J. H. Johnson, London.—30th September, 1878.
3709. Power Looms, W. Longbottom, Barnsley.—19th September, 1878.

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

3345. Stop, &c., Valves, W. H. Westwood, E. Wright, and E. T. Wright, Dudley.—30th September, 1874.
3150. Copies of Writings, E. de Zuccato, Soho, London.—15th September, 1874.
3242. Soda and Potash, J. Mactear, Glasgow.—22nd September, 1874.
3414. Fire-alarms, F. H. W. Higgins, London.—6th October, 1874.
3193. Lifting Apparatus, J. Holden, Halifax.—18th September, 1874.

Notices of Intention to Proceed with Applications.

Last day for filing opposition, 7th October, 1881.

2034. Fog Signal Apparatus, H. Whitehead, Bucknall, and T. Dodd, Winsford.—10th May, 1881.
2059. Designs on Marble, A. Guattari, Bedford-street, London.—11th May, 1881.
2061. Animal Charcoal, D. A. Fyfe, Barnes, Surrey.—12th May, 1881.
2062. Stretching Fabrics, S. Hallam, Manchester.—12th May, 1881.
2069. Expansion Gear, C. Pieper, Berlin.—A communication from W. R. Proell.—12th May, 1881.
2070. Stoppering Bottles, J. J. Broadbridge, Manchester.—12th May, 1881.
2084. Capstans, B. C. Scott, Regent's Park, London.—13th May, 1881.
2087. Taps or Valves, G. Osborne, Brighton.—13th May, 1881.
2088. Conveying Intelligence, J. M. B. Baker, Southampton-buildings, London.—13th May, 1881.
2090. Locking Bottle Moulds, W. A. and R. W. Smyth, Dublin.—13th May, 1881.
2099. Warping, &c., Machines, S. Cook, sen., and S. Cook, jun., Bury.—13th May, 1881.
2103. Printing Ink, C. T. Bastand, Albany-road, London.—13th May, 1881.
2108. Cotton Pile Plushes, W. Irlam, Eccles.—14th May, 1881.
2109. Controlling Speed of Steam Engines, H. Lindley, Salford.—14th May, 1881.
2118. Mandrils, C. Croissant and P. P. Huré, Paris.—14th May, 1881.
2120. Thrashing Machines, F. Wirth, Germany.—A communication from S. Moser.—14th May, 1881.
2145. Propelling, &c., Vessels, A. Figge, Old Cavendish-street, London.—16th May, 1881.
2148. Steam Engines, H. H. Lake, London.—A communication from J. W. Chisholm.—17th May, 1881.
2175. Electric Batteries, W. R. Lake, London.—A communication from L. Maiche.—18th May, 1881.
2330. Looms, W. Walker, Radcliffe Bridge, Lancashire.—30th May, 1881.
2407. Fire-arms, A. M. Clark, London.—A communication from A. Hape and A. Oliver.—31st May, 1881.
2410. Quarrying Slate, A. M. Clark, London.—A communication from A. R. Reese.—31st May, 1881.
2506. Tube Expanders, J. Hall and S. Thompson, Sunderland.—9th June, 1881.
2545. Gas Condensers, H. and F. C. Cockey, Frome Selwood.—10th June, 1881.
2546. Sewing Machine Gearing, H. J. Haddan, London.—Com. from M. I. Lecœur.—11th June, 1881.
2630. Monocycles, L. A. Pearce, Hammersmith.—18th June, 1881.
2830. Portable Knife and Fork, W. Wiley, Wolverhampton.—28th June, 1881.
2859. Treatment of Gas, J. E. Dowson, Westminster.—30th June, 1881.
2925. Preventing Incrustation in Boilers, H. A. Bonneville, Cannon-street, London.—A communication from P. Alfieri.—5th July, 1881.
3010. Making Cigarettes, A. M. Clark, London.—Com. from J. A. Bonsack.—9th July, 1881.
3031. Water-closets, &c., W. Dawes, W. H. and D. Thompson, Leeds.—14th July, 1881.
3210. Films, A. M. Clark, London.—A communication from B. Day.—26th July, 1881.
3437. Printing, &c., Machinery, W. R. Lake, London.—Com. from W. A. Scott.—11th August, 1881.
3500. Machine Embroidery, C. A. Barlow, Manchester.—Com. from J. Halter.—17th August, 1881.
3671. Printing Machines, J. H. Young and R. Paterson, Glasgow.—23rd August, 1881.
3733. Knitted Fabrics, F. Caldwell, Loughborough.—26th August, 1881.
2705. Brushes, B. J. B. Mills, London.—Com. from J. J. C. Smith and H. Gelpcke.—31st August, 1881.
3831. Tiles, H. Hall, St. Pancras, London.—1st September, 1881.

Last day for filing opposition, 11th October, 1881.

2121. Screw Propellers, W. R. Lake, London.—Com. from J. B. Root.—14th May, 1881.
2122. Gas Motor Engines, J. Dougill, Manchester.—16th May, 1881.
2123. Driving Belts, D. Williams, Portmadoc, North Wales.—16th May, 1881.
2124. Hydralic Caps, F. Wirth, Germany.—Com. from N. Frantz and F. Westmeyer.—16th May, 1881.
2131. Petroleum, F. H. F. Engel, Hamburg.—A communication from H. Koch.—16th May, 1881.
2132. Portable Crane, J. Hurst, Brighton.—16th May, 1881.
2137. Supporting Lasts, J. Southwood, Leeds.—17th May, 1881.
2144. Blasting Charges, W. E. Gedge, London.—A communication from L. Favre.—17th May, 1881.
2145. Sewing Machines, W. R. Lake, London.—A communicati on from D. H. Campbell.—17th May, 1881.
2146. Sewing Machines, W. R. Lake, London.—A communication from D. H. Campbell.—17th May, 1881.
2149. Fireplaces, T. F. Shillington, Belfast.—17th May, 1881.
2160. Attaching Knobs to Handles, E. S. Harvey and J. Brodie, London.—18th May, 1881.
2171. Extracting Metals, R. Stone, King William-street, London.—18th May, 1881.
2173. Riding Saddles, B. Walters and J. Hewitt, Finsbury, London.—18th May, 1881.
2174. Bricks, &c., J. Walker, Leeds.—18th May, 1881.
2177. Sock Suspender Clasp, E. Blinkhorn and F. A. C. Grœbert, Finsbury, London.—A communication from H. Axmann.—18th May, 1881.
2181. Fire-arms, W. W. Morton, Railway Approach, London Bridge.—19th May, 1881.
2184. Amalgamation of Gold, F. Campbell, Strand, London.—19th May, 1881.
2202. Bicycles, &c., E. Marshall, Birmingham.—19th May, 1881.
2216. Sewing Machines, J. Imray, London.—A communication from H. Buckofzer.—20th May, 1881.
2219. Steel, J. Imray, London.—A communication from P. E. Martin.—20th May, 1881.
2224. Sweetmeats, S. P. Wilding, Rood-lane, London.—A communication from Messrs. Thiele and Holzhause.—21st May, 1881.
2230. Air Compressors, H. Fletcher, Bolton-le-Moors, Lancashire.—21st May, 1881.
2258. Tricycles, H. J. Haddan, Strand, London.—Com. from J. McKenzie.—24th May, 1881.
2260. Metallic Alloy, W. L. Wise, Westminster.—Com. from K. H. Kühne.—24th May, 1881.
2261. Permanent Way, J. Livesey, Westminster.—24th May, 1881.
3265. Telephone Transmitting Apparatus, J. T. Gent and H. G. Ellery, Leicester.—24th May, 1881.
2282. Artistic Hangings, A. M. Clark, London.—A communication from A. Lotery.—24th May, 1881.
2314. Preserving Butter, G. M. Allender, Bayswater, London.—26th May, 1881.
2317. Purifying Gases, R. Good, Carshalton, and T. Dean, Croydon.—26th May, 1881.
2334. Furnaces, A. M. Clark, London.—A communication from J. Garnier.—27th May, 1881.
2343. Gas Regulators, W. Carter, Oldham.—27th May, 1881.
2386. Displaying Advertisements, H. J. Haddan, Strand, London.—A communication from A. Anderson.—31st May, 1881.
2401. Ploughs, J. Cooke, Linaolnshire.—31st May, 1881.
2438. Cleaning Cottonseed, G. Welburn, Grovehill, Beverley.—2nd June, 1881.
2517. Winding Tape, J. Imray, London.—Com. from La Société les Fils de Cartier Bresson.—9th June, 1881.
2558. Centrifugal Machines, W. Shears, Bankside.—13th June, 1881.
2706. Fixing Fabrics, W. P. Thomson, High Holborn, London.—Com. from M. F. Sallade.—20th June, 1881.
2966. Grain Binding Machine, G. E. Vaughan, London.—Com. from M. A. Keller.—7th July, 1881.
3048. Combing Machines, C. A. Barlow, Manchester.—Com. from P. P. Baudouin.—12th July, 1881.
3072. Compositions, C. F. Claus, Mark-lane, London.—14th July, 1881.
3122. Electric Bridges, St. G. L. Fox, Queen Anne's-gate, London.—18th July, 1881.
3237. Twist Lace Machines, J. R. Hancock, Crocus-street, Nottingham.—25th July, 1881.
3258. Steam Engines, D. Halpin, Victoria-chambers, London.—26th July, 1881.
3297. Utilising Peat Fibre, H. Armstrong, Darlington, and J. A. London, London.—28th July, 1881.
3318. Furnaces, W. H. Poole, Bolton.—30th July, 1881.
3394. Generating Electric Currents, St. G. L. Fox, London.—5th August, 1881.
3785. Products from Blast Furnaces, J. Alexander and A. K. McCosh, Lanark.—31st August, 1881.
3801. Mules, J. Chisholm and J. Clegg, Oldham.—1st September, 1881.
3876. Sewing Machines, W. R. Lake, London.—Com. from J. Anthony.—7th September, 1881.
3885. Fire Extinguishing Apparatus, W. R. Lake, London.—Com. from A. Burritt Hardware Company, Incorporated.—7th September, 1881.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 16th September, 1881.*)

1168. Indicating Apparatus, W. R. Lake, Southampton-buildings, London.—17th March, 1881.
1184. Pipe Joints, J. A. Berley, Peckham Rye, London.—18th March, 1881.
1196. Non-conducting Compositions, D. H. Dade, Bermondsey.—18th March, 1881.
1206. Electrical Apparatus, R. R. Harper, Finsbury, London.—19th March, 1881.
1235. Electric Lighting, G. A. Tabourin, Marseilles.—21st March, 1881.
1236. Electric Lamps, &c., J. A. Berley, Peckham Rye, London.—21st March, 1881.
1248. Twist Lace Machines, J. Newton, Kimberley.—22nd March, 1881.
1249. Taps or Cocks, P. O'Connor, Wavertree.—22nd March, 1881.
1250. Show-stands, L. A. Groth, Finsbury-pavement, London.—22nd March, 1881.
1252. Raising, &c., Sashes, J. W. Lewis, Halifax.—22nd March, 1881.
1255. Printing Fabrics, R. Ritchie and J. Ferguson, Dunfermline.—22nd March, 1881.
1261. Sulphocyanides, &c., H. E. Newton, Chancery-lane, London.—22nd March, 1881.
1267. Combined Couch and Armchair, F. W. Sinnock, Bristol, and G. R. Martin, Bath.—22nd March, 1881.
1303. Winding up Watches, H. H. Lake, Southampton-buildings, London.—23rd March, 1881.
1309. Safety Wicket, A. C. Henderson, Southampton-buildings, London.—24th March, 1881.
1363. Gas Motor Engines, S. and H. N. Bickerton, Ashton-under-Lyne.—28th March, 1881.
1439. Valves, W. H. Westwood and E. T. Wright, Dudley.—1st April, 1881.
1440. Preventing Boiler Explosions, B. Giles, Blackheath.—1st April, 1881.
1485. Preventing the Escape of Steam, &c., G. Tall and J. Daddy, Kingston-upon-Hull.—5th April, 1881.
2017. Soda, E. Solvay, Brussels.—9th May, 1881.
2113. Soda, E. Solvay, Brussels.—14th May, 1881.
2133. Rotary Engines, W. R. Lake, Southampton-buildings, London.—16th May, 1881.
2249. Heating Dwelling Houses, &c., C. L. Friedländer, Jönköping, Sweden.—24th May, 1881.
2391. Phosphate of Lime, E. Solvay, Brussels.—31st May, 1881.
2744. Metal Cans, C. Laurent, St. Pancras, and H. W. Brand, Mount-street, London.—23rd June, 1881.
2993. Breech-loading Small-arms, S. B. Allport, Birmingham.—7th July, 1881.

(*List of Letters Patent which passed the Great Seal on the 20th September, 1881.*)

1227. Cleaning Wheat, &c., E. Davies, Liverpool.—21st March, 1881.
1228. Condensation of Steam, T. Elcoate, Lord-street, Liverpool.—21st March, 1881.
1276. Cutting Paper, J. H. Johnson, Lincoln's-inn-fields, London.—23rd March, 1881.
1277. Furnaces, &c., H. G. Grant, Hopwood-avenue, Manchester.—23rd March, 1881.
1286. Reservoirs, O. Wolff, Schloss-strasse, Dresden.—23rd March, 1881.
1289. Soap, P. Jensen, Chancery-lane, London.—23rd March, 1881.
1298. Folding Crates, J. R. Kelsey, Strutton Ground, London.—23rd March, 1881.
1300. Metallic Appliances for Boots, A. Sumner, City-road, London.—23rd March, 1881.
1304. Binding for Scaffolding, J. Rettie, Hatton-garden, London.—23rd March, 1881.
1308. Securing Horseshoes, S. Gibbs, Herne Bay.—24th March, 1881.
1310. Cardboard Box Irons, G. Asher, Lower Edward-street, Balsall Heath, Birmingham.—24th March, 1881.
1311. Casing Shaft Bearings, &c., A. Howat, Manchester.—24th March, 1881.
1318. Sewing Machines, C. T. Bastand, Albany-road, Camberwell.—24th March, 1881.
1322. Iron, J. H. Johnson, Lincoln's-inn-fields, London.—24th March, 1881.
1327. Heating Stove, T. Morgan, Cockspur-street, London.—24th March, 1881.
1342. Brewing, &c., C. Clinch, Pynes-terrace, Exeter.—25th March, 1881.
1351. Capsuling Bottles, J. Dunbar, Glasgow.—26th March, 1881.
1370. Burning Hydrocarbon Oils, A. J. Boult, High Holborn, London.—28th March, 1881.
1375. Regulating Apparatus, F. W. Eames, Watertown, U.S., and J. McIntosh, Liverpool.—28th March, 1881.
1387. Riddling, &c., Cinders, T. Bradford, High Holborn, London.—29th March, 1881.
1411. Hydraulic Apparatus, E. de Pass, Fleet-street, London.—31st March, 1881.
1437. Knives and Forks, W. H. Stokes, Birmingham.—1st April, 1881.
1481. Raising Objects, G. Behrns and G. Unruh, Lübeck.—5th April, 1881.
1487. Colouring Matters, E. G. P. Thomas, Brentford.—5th April, 1881.
1488. Machine Guns, T. Nordenfeldt, St. Swithin's-lane, London.—5th April, 1881.
1519. Cravats, J. Hinks, T. Hooper, and F. R. Baker, Birmingham.—7th April, 1881.
1540. Railway Points, H. Whitehead, Bucknall, and T. Dodd, Winsford.—8th April, 1881.
1604. Astral Lanterns, F. H. Bailey, Hillsdale, U.S.—12th April, 1881.
1610. Umbrella Furniture, G. G. Lusher, Birmingham.—13th April, 1881.
1668. Curtains, G. Hurst, Nottingham.—16th April, 1881.
1758. Wire Brushes, G. W. von Nawrocki, Leipziger-strasse, Berlin.—23rd April, 1881.
1806. Metal Pipe, A. M. Clark, Chancery-lane, London.—26th April, 1881.
1920. Harvesting Machines, B. Samuelson and W. G. Manwaring, Banbury.—3rd May, 1881.
2310. Bleaching, &c., Cotton, W. Mather, Manchester.—26th May, 1881.
2482. Magneto, &c., Machines, E. G. Brewer, Chancery-lane, London.—7th June, 1881.
2492. Electric Lamps, P. Jensen, Chancery-lane, London.—8th June, 1881.
2499. Retorts, W. Grice, Birmingham.—8th June, 1881.
2574. Kneading Dough, B. J. B. Mills, Southampton-buildings, London.—14th June, 1881.
2638. Lamps, F. Siemens, Dresden.—17th June, 1881.
2716. Filtering Water, P. M. Justice, Southampton-buildings, London.—21st June, 1881.
2840. Grain, W. R. Lake, Southampton-buildings, London.—28th June, 1881.
2860. Sound Ingots, A. Longsdon, New Broad-street, London.—30th June, 1881.
2900. Cases for Eggs, W. J. Young, Bristol.—2nd July, 1881.
2949. Cotton Ropes, H. Birkmyre, Port Glasgow.—6th July, 1881.
2954. Magneto, &c., Machines, P. Jensen, Chancery-lane, London.—6th July, 1881.
3142. Purifying Alcoholic Liquors, W. R. Lake, Southampton-buildings, London.—19th July, 1881.
3278. Artificial Tooth Crowns, S. Pitt, Sutton.—26th July, 1881.

List of Specifications published during the week ending September 17th, 1881.

3907*, 4d.; 3047*, 4d.; 3782, 2d.; 4474, 2d.; 4604, 10d.; 5153, 8d.; 440, 6d.; 448, 6d.; 456, 6d.; 465, 6d.; 488, 4d.; 496, 2d.; 498, 8d.; 506, 8d.; 511, 6d.; 512, 6d.; 514, 6d.; 522, 6d.; 539, 8d.; 562, 8d.; 567, 8d.; 568, 4d.; 596, 6d.; 600, 4d.; 610, 6d.; 619, 6d.; 629, 6d.; 630, 6d.; 634, 6d.; 636, 6d.; 637, 6d.; 640, 2d.; 642, 6d.; 643, 2d.; 645, 2d.; 646, 6d.; 647, 2d.; 651, 6d.; 657, 2d.; 658, 2d.; 659, 2d.; 661, 6d.; 662, 6d.; 663, 1s.; 664, 4d.; 666, 2d.; 669, 2d.; 670, 2d.; 671, 6d.; 677, 8d.; 681, 4d.; 683, 2d.; 686, 2d.; 688, 2d.; 689, 2d.; 691, 2d.; 692, 2d.; 694, 6d.; 696, 6d.; 701, 4d.; 703, 2d.; 705, 2d.; 706, 2d.; 707, 2d.; 708, 2d.; 710, 2d.; 711, 2d.; 715, 2d.; 718, 2d.; 719, 2d.; 720, 2d.; 723, 2d.; 725, 4d.; 727, 6d.; 729, 6d.; 731, 2d.; 734, 2d.; 737, 2d.; 738, 4d.; 740, 2d.; 741, 2d.; 745, 2d.; 742, 2d.; 750, 4d.; 1209, 4d.; 1390, 4d.; 1476, 2d.; 2394, 6d.; 2587, 6d.; 2590, 6d.; 2774, 6d.

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

ABSTRACTS OF SPECIFICATIONS.

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

440. Supplying, Heating, and Circulating Water for Domestic Purposes, &c., *T. Jackson.—2nd February*, 1881. *6d.*

This relates principally to the general construction or combination of the parts of kitchen ranges with a high-pressure boiler and its water supplying and circulating fittings with branch feed pipes and cocks or valves, for supplying water from the cisterns in any flat above it, and circulating it through the boiler from said cisterns.

448. Lamps and Lamp Stoves, *E. A. and J. D. Rippingille.—2nd February*, 1881. *6d.*

This relates, First, to the methods of indicating the height of oil in the metal tanks or reservoirs of lamps and lamp stoves; Secondly, to the methods of heating the bottoms of ovens or lamp stoves; Thirdly, to constructing lamp stoves with one or more burners and chimneys intermediate of the side burners, and forming an oven on each side of such intermediate chimney or chimneys.

456. Combined Muff, Bag, and Reticule, *J. Pick.—3rd February*, 1881. *6d.*

This consists in the arrangement of the article comprising in one and the same a muff, bag, and reticule.

465. Bucking, Washing, and Bleaching Linen, &c., *A. M. Clark.—3rd February*, 1881.—*(A communication from A. Michel.)—(Not proceeded with.)* *6d.*

This consists essentially of one or several revolving drums constructed of wood or metal, and adapted to be driven together or separately. Each drum or cylinder is divided into three or more compartments, in order that the linen or other material may be sorted, and lyes of different degrees of concentration applied to each kind of material.

511. Fastener for Gloves, &c., *G. Horsepool.—7th February*, 1881. *6d.*

This consists in attaching a plate to one side of the opening of a glove. The plate is cut or stamped out in the middle for the reception of a flat tongue-shaped spring secured at one of its ends by being rivetted to the plate. A small curved lever is hinge jointed or pivotted on to the plate in such manner that when the said lever is pushed over in one direction its short end presses against the spring under it until the long end lies flat on the plate, in which position it is maintained by the pressure of the spring on its short end. The mode of fastening is to pass the button-hole, or it may be an eyelet hole, on one side of the glove opening over the long end of the said lever on the other side of the opening.

488. Making the Joints of Moulds for Casting Steel under Pressure, &c., *C. J. Allport.—4th February*, 1881. *4d.*

This consists in the employment of asbestos mill-board or asbestos cloth or rope, or asbestos in other

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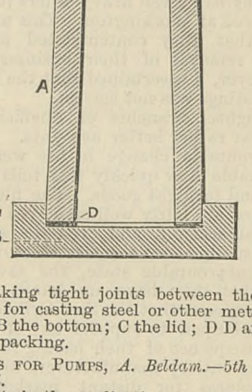

form, for making tight joints between the parts of moulds used for casting steel or other metals. A is the mould; B the bottom; C the lid; D D are rings of the asbestos packing.

496. Valves for Pumps, *A. Beldam.—5th February*, 1881. *2d.*

This consists in the application of metallic or other discs in combination with lignum vitæ or other suitable substance, forming a bush or collar, allowing it to rise or fall upon the rod or pin.

498. Kilns, *E. Edmonds.—5th February*, 1881.—*(A communication from C. Amand.)* *8d.*

The kiln is composed of a gallery or bricked chamber A, which is constructed on walls of masonry arranged in such manner as to permit the circulation of atmo-

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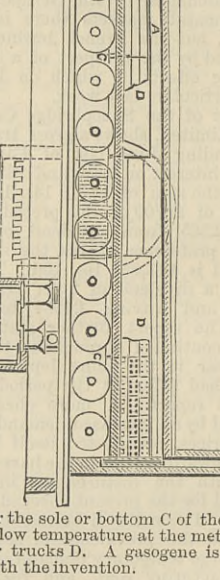

spheric air under the sole or bottom C of the kiln and thus maintain a low temperature at the metallic parts of the wagons or trucks D. A gasogene is employed in connection with the invention.

506. Fixing Rails on Metallic Sleepers, *F. C. Glaser.—5th February*, 1881.—*(A communication J. A. J. Vantherin.)* *8d.*

This refers to a method of fixing rails to metallic sleepers by means of excentric appliances, which can be securely locked, and yet allow of the line being easily and simply adjusted to gauge. The drawing is an elevation partly in section, showing one method of

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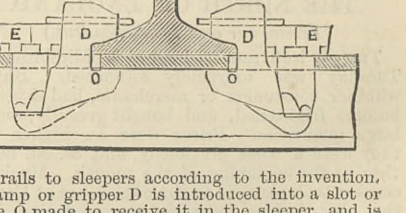

fixing rails to sleepers according to the invention. The cramp or gripper D is introduced into a slot or mortice O made to receive it in the sleeper, and is pushed on the foot of the rail, embracing and retaining it between its jaws. The operation of locking and securing the cramp or gripper is effected by means of the adjustable excentric bolt E.

514. Driving Small Machines by Compressed Air, *L. Boye and E. Müller.—7th February*, 1881. *6d.*

Atmospheric air is compressed into a reservoir B by means of a hand-pump A, and this compressed air is

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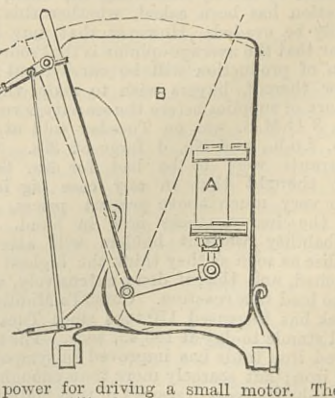

utilised as power for driving a small motor. The compressed air is utilised in an oscillating engine, similar to that of an ordinary steam engine.

512. Bicycles, Tricycles, &c., *J. White and G. Davies.—7th February*, 1881. *6d.*

This consists, First, in the construction of the saddle or seat spring with an india-rubber bush at each end. Secondly, in the construction and application of a clutch working by means of inclines or wedge pieces acting inside a box or recess in the hub. Thirdly, in the application in combination with the roller clutch of a sliding clutch to facilitate "back pedalling." Fourthly, in the construction and application to the steering handle of velocipedes having two driving wheels of equal size, of a grooved cam so constructed as to unlock the inner or corresponding wheel whenever the steering handle is turned either to the right or left.

522. LOOMS, *J. Hollingworth.—7th February*, 1881. 6d.

In the drawing, A is the pattern surface or peg-lags passing around the barrel B; and C are the bell-crank levers with their upper ends resting upon and being lifted by the pattern surface in the usual manner; D is a lever having a pin E at its lower end working within a slot formed in the arm of another lever F; one end of this slotted lever F is connected to and

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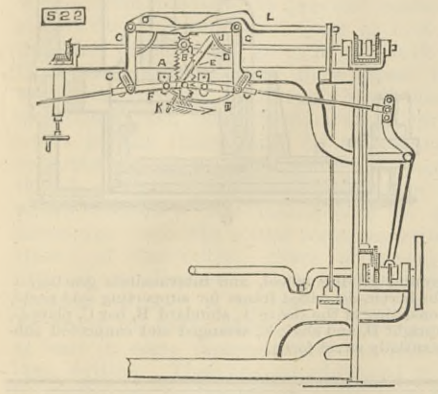

works within a slot G formed in the hanging arm of the other bell-crank lever; C is connected to the slotted lever F by a third lever I, by which means the parts are coupled together and actuated simultaneously. On the other end of the shaft or stud J, upon which the lever D is keyed, is also keyed the reversing handle K, so that when the said handle K is moved in the direction of the arrow, the whole of the levers are operated, and the bell-crank levers and picking lever L are removed off the peg-lags, consequently the weight thereof is removed, and the operation of lagging back is rendered easy, which is not the case when the weights of the levers are resting upon the pattern surface during the time the weaver is lagging back.

539. ELECTRIC LAMPS, *E. G. Brewer.—8th February, 1881.—(A communication from T. A. Edison.)* 8d.

One of the objects of this invention is to make a lamp in which the light-giving portion is in a straight line, as shown in the figure. Upon the glass bulb B is secured a glass arm D, rising to a little greater height above B than the length designed to be given to the carbon, the arm D then turning at about a right angle. A conductor is either fused into D or bound

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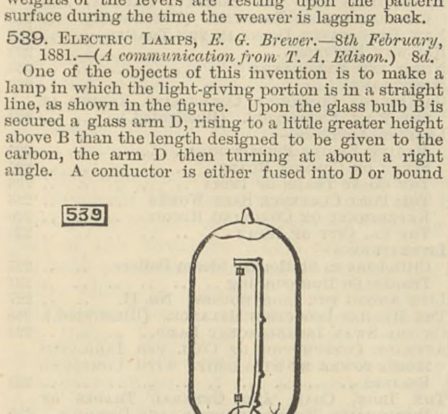

thereto; this conductor has at its top end a clamp, to which is secured one end of the carbon, the lower end of which is secured in another clamp in connection with another conductor. In manufacturing the lamp the supporting arm, conductors, and carbon are first placed in position upon B, the glass support and enclosing globe are then united and the globe exhausted. The specification also refers to other improvements in incandescent lamps.

562. CARBON BURNERS FOR INCANDESCENT CONDUCTORS, &c., *P. Jensen.—9th February, 1881.—(A communication from T. A. Edison.)* 8d.

To form flexible and pure carbons for incandescent lamps, the inventor takes thin sheet metal that will stand high temperatures, such as nickel or cobalt, and cuts it into the desired shape. One or several such pieces of metal are suspended in a closed flask, which is then heated to a high temperature; while in this heated condition the vapour of a volatile carbon is passed through the flask, with the result that the carbon is deposited on the metal shapes. The flask is allowed to cool when sufficient carbon has been deposited in the metal pieces; they are then taken out and immersed in some acid having an affinity for the metal used, and the metal thereby eaten away, leaving the pure carbon in the desired shape.

567. WELDING TUBES, *A. and J. Stewart and J. Wotherspoon.—10th February*, 1881. 8d.

The essential feature of this invention is the causing of the part of the tube to be welded to be passed or to

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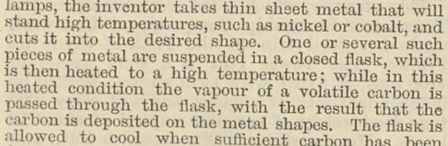

pass between rolls respectively bearing with the requisite pressure upon the interior and exterior of the tube.

568. FIRE-BARS FOR FURNACES, *A. Murfet.—10th February*, 1881. 4d.

Each bar consists of a vertical web for a portion of its depth, the lower edge of which is thicker than the upper part, above which the bar is gradually grooved until the top edge or face of the bar forms a number of

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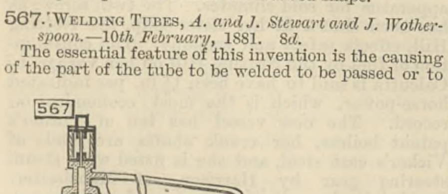

oblongs, the open ends of which lie exactly opposite the closed ends of the oblongs of the next adjacent bars on each side of it; each bar has a square shoulder at each end; each shoulder is grooved or slotted vertically of such form that when a number of such bars are placed in position the upper surfaces occupy less space than the air space, and likewise enables the stoker or other attendant to insert a pointed rake or pricker bar, and clear the spaces of cinder or clinker from end to end at will. The drawing is a sectional view of two bars through the centre of their length.

596. DILATED AIR MOTIVE POWER ENGINES, *P. Giffard.—11th February*, 1881. 6d.

This relates to an engine actuated by compressed and heated air, and consisting of a compressing pump, a superheating fireplace or fire-box, formed partly by the air inlet pipe (of spiral or other suitable form), of the inlet and outlet valves actuated by cams or excentrics, of a motive piston of considerable length allowing the hermetic joint to be placed at a distance from the source of heat, said piston operating in a cylinder provided with a reservoir for containing cooling liquid.

600. CORDS FOR SUSPENDING PICTURES, &c., *J. D. Sprague.—11th February*, 1881. 4d.

This consists in twisting one, two, or more strands of wire made of any suitable metal or alloy, or of hemp, flax, or other suitable fibrous material, so as to form a line or cord, but having loops or eyes at regular intervals, such loops or eyes serving to receive one end of a double hook, the other end of the hook being inserted in the ring or other attachment to the picture.

610. PAVING FLOORS, &c., *P. Stuart.—12th February*, 1881. 6d.

This consists in manufacturing composite pavements, &c., of a foundation of broken dry stones, a layer of compressed concrete, and a layer of a composition of broken or cubed granite and cement, with or without the addition of ground or pulverised hematite, magnetic, or other iron ore or colouring matter, and with or without strengthening iron rods and wires embedded between the said composition and the concrete.

619. GAS-HEATED SMOOTHING IRONS, *R. Macaulay and J. Ballintine.—14th February*, 1881. 6d.

The hollow body of the iron is formed of two iron castings, one of which comprises the bottom and curved sides, whilst the other comprises the flat end and the top, and has the handle permanently fixed to it. The two parts of the hollow body are connected together partly by the burner pipe, and partly by a screw at the top of the pointed end.

629. FEED APPARATUS FOR THRASHING MACHINES, *A. M. Clark.—14th February, 1881.—(A communication from A. L. Dudoüy.)* 6d.

This consists essentially of a number of prongs or tines hung loosely on and operated by a cranked shaft, and so guided as to be caused to take a back-

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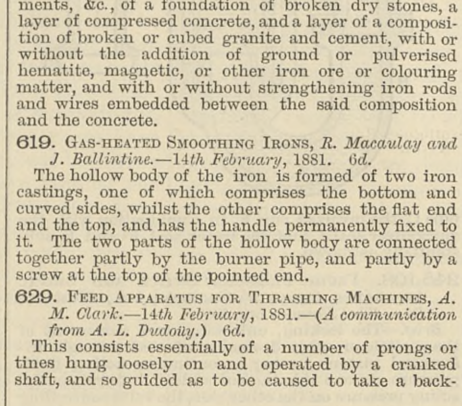

ward movement above the straw, and a downward and forward movement for entering the straw and feeding it to the thrashing drum. The drawing is a section.

630. APPARATUS FOR DRAWING AND MEASURING BEER FROM CASKS, &c., *T. Slade.—14th February*, 1881. 6d.

This relates to the arrangement and combination of apparatus for drawing off beer or other liquids from casks or other vessels, by conducting it into a tank or intermediate chamber, having a stand pipe and graduated scale to indicate the level of the liquid contained in the cask or other empty vessel, the intermediate vessel or chamber being also arranged in combination with the lifting pump or engine, and with stand pipes and indicating apparatus at a higher level.

634. READING AND PUNCHING JACQUARD CARDS, *B. Toone.—15th February*, 1881. 6d.

In a punching machine of the usual construction a cross-bar of metal is employed, having each end secured to and carried by one of the sliding bars which operate the selecting block; the cross-bar supports an additional needle block of peculiar construction, being formed of two or more sley plates perforated for needles, each needle having an eye at one end and a hook at the opposite end; each needle is provided with a metal collar, which restricts the traverse of the needle between the sley plates; the whole block is capable of adjustment in length and width by means of set screws. Each needle is attached by means of two or more strings to two or more of the needles in the original selecting block, according to the number of repeats of pattern required; the back ends of the needles in the additional block have the ends of the wale strings hooked on to them.

636. DESICCATING OR PRESERVING POTATOES, &c., *G. L. Laird.—15th February*, 1881. 6d.

This consists in the process of desiccating or preserving potato and other kindred foods by passing through the prepared mash a current of heated air at a pressure considerably above the atmosphere obtained by means of a blower, blowing engine, or other equivalent mechanism delivering a regulated current of uniform pressure through the apparatus.

637. ROLLING MILLS FOR THE MANUFACTURE OF IRON AND STEEL, *P. Kirk.—15th February*, 1881. 6d.

This relates to improvements on patent No. 470, dated 7th February, 1876. The object is to still further increase the duty of the mill, principally in order to be able to complete rails and heavy bars by rolling down from the ingot or bloom with one heat.

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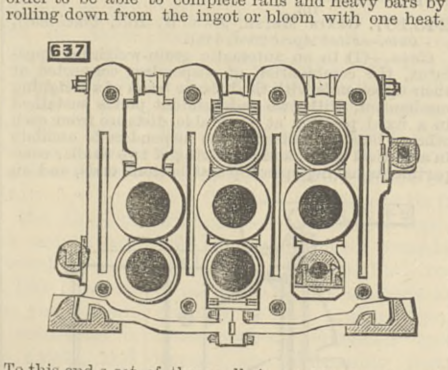

To this end a set of three rolls is combined with a set of two rolls in such a manner as that two reductions can be obtained by passing between the lower rolls, and then two reductions by passing between the upper rolls, and *vice versâ*.

640. SUPPORTING AND LUBRICATING THE SPINDLES OF RING SPINNING FRAMES, *H. J. Haddan.—15th February, 1881.—(A communication from J. W. Wattles.)—(Not proceeded with.)* 2d.

An oil cup or reservoir is provided with a screw-threaded shank and a nut to screw thereon, the said appliances being for fixing the reservoir to the spindle rail of spinning frames. The said reservoir has a tubular post or oil induct extending up from it on its outside, the bore of such post being made to open into the reservoir.

642. CHILDREN'S COTS, *G. W. Moon.—15th February*, 1881. 6d.

This relates to the construction of children's cots in such manner that they may be lengthened or shortened according to the height of the child.

643. VELVET TISSUES, *A. C. Henderson.—15th February, 1881.—(A communication from Messieurs Martin, Williams, and Co.)—(Not proceeded with.)* 2d.

The weft which constitutes the ground is of 40 twist cotton, and that forming the velvet of 12 ply hemp. The first warp serves to form the ground of the tissue; it is borne on a separate roller, and should be stretched as in the manufacture of all other tissues. The second warp serves to bind the weft that is to form the velvet; it secures it below the tissue, and used in this way it allows the knife to slide more easily, and prevents cutting the ground of the tissue.

645. STEAMING OR CLEANING CASKS, *A. Heathorn.—15th February, 1881.—(Not proceeded with.)* 2d.

This relates to means for obviating the waste of time incurred in turning off the steam when one cask is cleaned, whereby all the other casks on the same pipe are delayed while the one cask that is cleaned is taken off the nozzle and a fresh one put on.

646. PACKAGES OR CASES FOR ARTICLES OF MERCHANDISE, &c., *W. E. Gedge.—15th February, 1881.—(A communication from R. S. Jennings.)* 6d.

This relates to the construction of composite veneering packages.

647. PADLOCKS, *T. Harby.—15th February, 1881.—(Not proceeded with.)* 2d.

This relates to improvements on that class of padlock the hasp of which allows of the padlock when unfastened dropping away from the loops or staples to which it is applied, and thereby provides against fraud from the hasp being apparently secured, while it is in fact only wedged into its locked position.

651. SHEEP-SHEARS, *A. M. Clark.—15th February, 1881.—(A communication from C. Benavides and J. P. Arthur.)* 6d.

This consists in constructing sheep shears with separable blades, whereby the blades can be ground without being injured.

657. VENTILATING MINES, &c., *J. Knox, G. Falconer, R. Burns, and A. Knox.—15th February, 1881.—(Not proceeded with.)* 2d.

This relates, First, to the extraction of foul air by means of piping from mines and other places requiring ventilation; Secondly, regulating valves and receivers of foul air distributed throughout the mine or place at the extremities of the piping; and Thirdly, a motive power for causing draught in the pipes.

658. MEDICINAL COMPOUND OR BEVERAGE, *G. W. Hamilton.—16th February, 1881.—(Not proceeded with.)* 2d.

This consists of $\frac{1}{2}$ lb. of taraxacum, 1 gallon of water containing gas, and from 6 oz. to 8 oz. of an extract from grapes under pressure.

659. CONTROLLING THE OPENING AND CLOSING OF VALVES, *H. W. Pearson.—16th February, 1881.—(Not proceeded with.)* 2d.

This relates to an arrangement of apparatus applicable to inlet valves opened by raising their spindles, and to outlet valves operated in a similar way, whereby the opening of an inlet valve or inlet valves will automatically lock the waste valve, and so also that when the outlet valve is open the inlet valve or valves cannot be opened.

661. ROOFS FOR SHEEP RACKS AND TROUGHS COMBINED, TRUCKS, &c., *E. Thomas.—16th February*, 1881. 6d.

The roofs or covers are hinged or pivotted to the ends or other parts of the article by means of frames, bell-crank levers, or their equivalent, in such manner that when fully opened, and also when entirely closed, the roof shall be in stable equilibrium.

662. HANDLES FOR RACKETS OR LAWN TENNIS BATS, *O. E. Woodhouse.—16th February*, 1881. 6d.

This relates to the form given to the handle.

663. TELEPHONIC APPARATUS AND SIGNALS THEREFOR, *P. M. Justice.—16th February, 1881.—(A communication from H. R. Miller.)* 1s.

This invention relates to a method of locking out all stations but the sending and receiving stations in a telephonic circuit, and also to an improved electric signal for telephone or other lines. The figure shows the connections. The circuit of the transmitter

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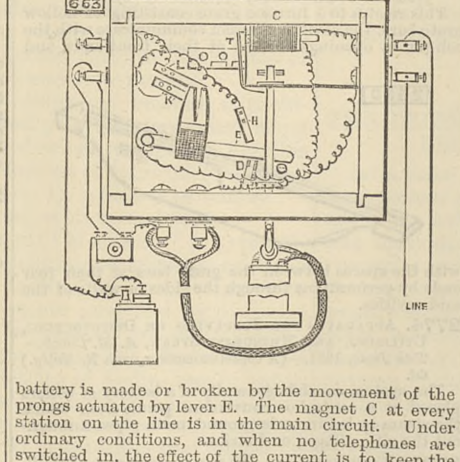

battery is made or broken by the movement of the prongs actuated by lever E. The magnet C at every station on the line is in the main circuit. Under ordinary conditions, and when no telephones are switched in, the effect of the current is to keep the armature T drawn up and the rod G unlocked, but when an operator at any given station is called he unhooks and shunts in his telephone, the great resistance of which being brought into line so weakens the current that it will no longer act upon the electro-magnet C sufficiently to draw up the armature, and these armatures in the whole circuit will therefore fall back by their own gravity, and lock all the rods through which the shunting devices are operated, except that from which the telephone has been removed. The operation of the shunting device is as follows:—The rod is pushed up, the shunting lever E is lifted so that it leaves D and is moved upon H, on which it is held by friction; at same time the points of the plate are shifted so as to enclose L and K. The movement of lever from D to H shunts in the telephone, and that of plate I closes the circuit of local battery. The remainder of the specification describes the inventor's new electric signal.

664. PAINTING IN OIL UPON FABRICS, *J. C. Mewburn.—16th February, 1881.—(A communication from A. Gutmann.)* 4d.

This consists, First, in exposing the fabric to the vapour of a hot liquor composed of distilled water, molasses, benzine, turpentine, spirits of wine, and nitro-benzole; and Secondly, in the addition to the oil-colours of a few drops of a cold liquor composed of benzine, turpentine, spirits of wine, and nitro-benzole.

666. APPARATUS TO BE USED ON LOCOMOTIVE ENGINES, &c., FOR REMOVING SNOW OR OTHER OBSTRUCTIONS, *W. L. Roberts.—16th February, 1881.—(Not proceeded with.)* 2d.

A case is formed so as to enclose the front, sides, and top of the engine, and of such a shape as to cut into the snow. The inner part of the front is formed as a receptacle for steam.

669. ARTIFICIAL BAIT FOR FISHING, *J. Richardson.—16th February*, 1881. 2d.

The bait is made of sole skin, painted and varnished.

670. BOILING, WASHING, AND FINISHING WOVEN FABRICS IN ROPE FORM, *W. Hutchinson.—16th February, 1881.—(Not proceeded with.)* 2d.

In boiling woven fabrics the boiling kier commonly used is dispensed with, or a kier is used and is caused to rotate by a worm and wheel or otherwise. When the kier is dispensed with, a steam pipe is placed in the cistern or washing machine, through which the fabric is usually passed after it has been boiled in the kier. The fabric is caused to pass into and out of the cistern which is filled with water or liquor, and over and under the ordinary bowls or rollers. Any desired number of squeezing rollers may be employed.

671. VELOCIPEDES, &c., *A. Kirby.—16th February*, 1881. 6d.

This consists in the application of that form of gearing which is technically known as "sun-and-planet," to the driving, propelling, or communicating rotary motion to the driving wheels of velocipedes.

677. SEWING MACHINES, *A. Anderson and G. Browning.—16th February*, 1881. 8d.

This relates, First, to an arrangement for engaging and disengaging the fly or balance wheel from actuating or ceasing to actuate the driving shaft of sewing machines at particular points of the stroke of the needle; Secondly, to improvements in the needle clamps; Thirdly, to improvements in the shuttles; and Fourthly, to improvements in the winders.

681. RECOVERY OF MATTERS CONTAINED IN SALINE LIQUORS PRODUCED IN SOAP MANUFACTURE, *W. R. Lake.—16th February, 1881.—(A communication from C. V. Clolus.)* 4d.

This consists, First, in the treatment of the water or liquor by hydrochloric acid or carbonic acid or by both simultaneously, for the purpose of separating therefrom the salts and fatty matters contained, and for obtaining water containing glycerine; Secondly, the subsequent treatment of the aforesaid water or liquor by functional evaporation; Thirdly, the introduction of air for de-hydrating the glycerine; Fourthly, the precipitation of the bay or marine salt in the glycerine by means of hydrochloric acid.

683. BRIDLE BIT, *E. L. Anderson.—17th February, 1881.—(Not proceeded with.)* 2d.

This relates to a bridle bit having a plain-curved or other stiff mouthpiece, with the check-pieces composed of two arms on each side standing at right angles to each other from the mouthpiece.

686. MANUFACTURE OF CUFFS, *J. Felsenstein.—17th February, 1881.—(Not proceeded with.)* 2d.

Springs are adapted to the cuff so as to impart a suitable form.

688. JOINT FASTENERS, *H. J. Haddan.—17th February, 1881.—(A communication from T. H. Alexander and A. A. Nicholson.)—(Not proceeded with.)* 2d.

This consists in a suitably shaped strip of spring or malleable metal sharpened or pointed at one end, then bent at a right angle to be driven in one of the parts forming the joint, while its opposite end is bent to about the angle at which the joint is formed and provided with an oblong hole through which a screw is inserted into the other piece forming the joint.

689. PIG IRON, *J. B. Thorneycroft.—17th February, 1881.—(Not proceeded with.)* 2d.

This relates to avoiding the too rapid and unequal cooling, and for this purpose special moulds are provided, together with apparatus and arrangements for heating such moulds before the iron is run into them.

691. STEAMING TEXTILE FABRICS, *E. H. Hargreaves and J. B. Green.—17th February, 1881.—(Not proceeded with.)* 2d.

This consists principally in the use in the apparatus of steam pipes or chests perforated or provided with small holes, through which issue jets of steam which impinge directly upon both surfaces of the cloth or textile fabric as the latter is drawn along between the said steam pipes or chests.

692. ORNAMENTAL PRINTING UPON CALICO, PAPER, &c., *C. R. F. Schlosser.—17th February, 1881.—(Not proceeded with.)* 2d.

The pattern is printed from blocks upon the fabric in gum, size, varnish, or other adhesive material, and then "wood flour" or "wood meal" is applied thereto.

694. TOOL-HOLDERS FOR SLOTTING MACHINES AND LATHE BOXES, *W. Timms.—17th February*, 1881. 6d.

This consists in the use of a taper bar for holding

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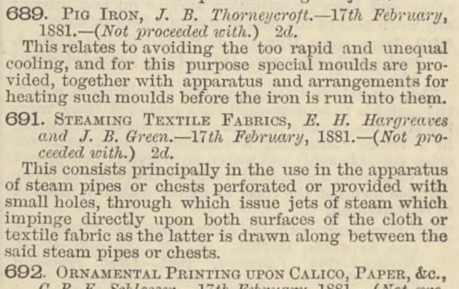

the tool set in another bar either axially with it or at right angles to it.

696. APPARATUS FOR WORKING THE BRAKES OF RAILWAY TRAINS, *C. W. Siemens and A. C. Boothby.—17th February*, 1881. 6d.

According to this invention, a dynamo-electric machine on the locomotive is connected with the coils of revolving armatures of magneto-electric or electro-magnetic machines on the brake carriages, so that the currents sent from the generator on the engine cause the armatures to revolve, and these are made to operate the brakes. The connection of the poles of the generator with the conductor is effected by a switch, so that the direction of the currents can be reversed, and the armatures made to revolve one way to apply the brakes and the reverse way to take them off. The generator is always kept going slowly and sending a feeble current to the wires and apparatus, but not sufficient to actuate the brakes; it is also connected with a galvanometer, so that any defect may at once be indicated. The system of braking used by preference is as follows:—An extension of the axis of the revolving armature carries a worm in gear with a worm wheel on a shaft, the motion of which is imparted either by pulleys or cords to the levers that operate the brake blocks, the arrangement being such that when the worms on the armature axes are rotated one way, they turn the worm wheel and shaft and apply the brake; contrarywise they take it off.

701. MAGNESIA, &c., *A. M. Clark.—17th February, 1881.—(A communication from J. B. M. P. Closson.)—(Not proceeded with.)* 4d.

This consists in treating calcined dolomite with sugar so as to separate the lime by forming a saccharate of lime, thus separating the magnesia.

703. KNITTING MACHINES, *J. H. Smith.—18th February, 1881.—(Not proceeded with.)* 2d.

This relates partly to the construction of the frame and partly to arrangements to ensure only one striker falling at a time.

705. METAL SUBSTITUTE FOR PUTTY, *F. W. Fletcher.—18th February, 1881.—(Not proceeded with.)* 2d.

This consists in the use of a length or strip of thin hard metal or alloy curved in its width, which is fixed to any ordinary glazing bar in such a position that one edge of its convex surface shall press firmly and evenly on the surface of the glass.

706. CLOSE AND OPEN COOKING RANGES, *J. H. Jack.—18th February, 1881.—(Not proceeded with.)* 2d.

This consists in forming a flue opening or doorway in the vertical back or "cove plate" leading right into the central back flue of the brickwork and fire, over the hot plate forming the top of the range above the oven, fire and boiler, and which faces or closes in the vertical flues therefrom.

707. SECURING WINDOW BLINDS TO ROLLERS, *R. Brierley.—18th February, 1881.—(Not proceeded with.)* 2d.

This consists in providing a groove running lengthwise of the roller to receive the end of the window blind, which is held fast in the window groove by a strip of wood or metal fitting easily therein.

708. Moulding Bottles, &c., *J. Lyons.—18th February*, 1881.—*(Not proceeded with.)* 2d.

This consists in moulding the bottle inside and out.

710. Ornamentation of Tweed Cloths, *R. F. and T. L. Watson.—18th February*, 1881.—*(Not proceeded with.)* 2d.

This consists in the introduction of tinsel or gold and silver wire or thread, or gilded and silvered wire and thread or tinsel, or wire and thread or other metals, so as to produce spots or stars of a bright or glistening appearance on the surface of the cloth.

711. Decanters, Bottles, Jugs, &c., *E. J. Collis.—18th February*, 1881.—*(Not proceeded with.)* 2d.

This consists in forming the articles to make up one group, each in a segmental shape or plan, so that when put together they form a complete solid figure, or with narrow divisions between them.

715. Electric Lamps, &c., *J. G. Tongue.—18th February*, 1881.—*(A communication from Dr. A. Lacomme.)—(Not proceeded with.)* 2d.

This invention has for its object improvements in and connected with electric lamps, and also for other lighting and heating purposes, and consists of mounting two or more pairs of carbons on an axis, so that after a definite time has elapsed, of a duration nearly equal to the time the carbons will last, the axis and connections receive a partial rotation by means of a current attracting an armature or other device. The inventor also surrounds the negative carbon with a carbon tube insulated from each other.

718. Phantasmagoria or Magic Lanterns, *E. P. Alexander.—19th February*, 1881.—*(A communication from A. L. Laverne.)—(Not proceeded with.)* 2d.

This consists partly in making the slotted cap or diaphragm which serves to regulate the flame and fits over the burner of the lamp, of such a form as will best resist all tendency to distortion or deformation which would be liable to impair the light-giving quality of the flame.

719. Destroying Explosive Gases in Mines, *W. Morgan.—19th February*, 1881. — *(Not proceeded with.)* 2d.

This relates to the use and application of electricity for the production of electric sparks for igniting and destroying the carburetted hydrogen gas as it collects in coal and other mines.

720. Nails for Protection of Boots and Shoes, *A. Burton.—19th February*, 1881.—*(Not proceeded with.)* 2d.

The heads are so formed (by preference segmental) that they may be placed in close proximity to each other, and form a continuous surface on and around any worn part of the heel or sole of a boot or shoe.

723. Depositing Metals, *J. C. Maltby and G. Bradford.—19th February*, 1881.—*(Not proceeded with.)* 2d.

This consists in immersing the article upon which the metal is to be deposited for a period of time varying according to the thickness of the deposit required, in a vessel containing a solution of aqua-fortis (or other suitable acid) and water, in which is also placed and immersed a sufficient quantity (in plates or other suitable form) of the class of metal which is desired to be deposited.

725. Covering the Rollers Used in Preparing and Spinning Cotton, *W., W. J., and C. H. Haynes.—19th February*, 1881.—*(Not proceeded with.)* 2d.

This consists in the application of leather made of equal substance and dressed with oil, and known as oil leather, to the purpose of covering the rollers used in preparing and spinning cotton.

727. Flushing and Ventilating Drains, &c., *S. H. Adams.—19th February*, 1881. 6d.

This consists of a syphon, by preference of a rectangular form, having an internal smaller syphon, which is for the purpose of discharging with a small flow of liquid into the falling or outlet leg of the

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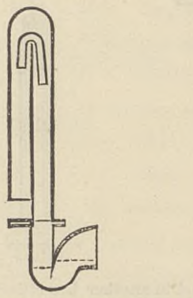

larger syphon. This action of the liquid through the smaller internal syphon has the effect of quickly withdrawing the air from the larger syphon, and consequently bringing it into action.

729. Bicycles, Tricycles, &c., *G. G. M. Vernum.—19th February*, 1881. 6d.

This relates, First, to the method of adjusting the bearings; Secondly, to the arrangement of parts for transmitting the rotary motion of the crank shaft.

731. Manufacture of Rails for Railways, *A. C. Henderson.—21st February*, 1881.—*(A communication from E. W. M. Tasse.)—(Not proceeded with.)* 2d.

This consists in the manufacture of triple-headed rails for railways, the heads being equidistant and within the same radius, the object of such construction being that when any of the heads are worn they can be turned, and so present a fresh surface or head, so that the rail is not removed as waste iron, which is the case with the single-headed rails.

734. Footballs, *W. E. Bussey.—21st February*, 1881. —*(Not proceeded with.)* 2d.

This relates to the construction of the cases of footballs.

737. Preserving Fruits, *B. J. B. Mills.—21st February*, 1881.—*(A communication from A. J. Magaud.)—(Not proceeded with.)* 2d.

This relates to the employment of a shell or envelope of cement or other material.

738. Simultaneously Manufacturing Steel and Lighting Gas, *P. Aube.—21st February*, 1881. 4d.

This relates to making steel, converting iron into steel, or inferior sorts of steel into fine steel, and to the manufacture at the same time of combustible gas applicable for lighting or heating purposes.

740. Holding and Raising Sacks, &c., *S. Wilkerson.—21st February*, 1881.—*(Not proceeded with.)* 2d.

This relates to apparatus for holding and automatically raising to a vertical, or nearly vertical position, sacks or similar receptacles when being filled with grain, &c., and also to the combination of such apparatus with a weighing machine for weighing the filled sacks.

741. Manufacture of Ink, *A. F. Stoddart.—21st February*, 1881. 2d.

This relates to the application of spent ooze or tan liquor in the manufacture of ink.

745. Locomotive Engines, *B. H. Lake.—21st February*, 1881.—*(A communication from C. B. Clark.)—(Not proceeded with.)* 2d.

This relates to locomotives which are driven by their frictional contact of one or more pairs of upper driving wheels with one or more pairs of lower wheels that rest upon the rails.

749. Colouring Matters, *C. D. Abel.—22nd February*, 1881.—*(A communication from C. A. Martius.)* 2d.

This consists in a new manufacture of blue colouring matter called phenylene, produced by treating the sulpho-acid of bimethyleazobenzole — yellow colouring matter known in commerce as helianthim, or methyle-orange, or orange III—with polysulphide of ammonia, and the oxidation of the bimethylethiophenylediamin thus formed by perchloride of iron.

750. Colouring Matters, *C. D. Abel.—22nd February*, 1881.—*(A communication from C. A. Martius.)* 4d.

This consists, First, in the production of orange, red, and brown colouring matters by combining the sulpho-acids of diazomethylenapthaline with betanaphthole or its sulpho-acids; Secondly, the production of orange, red, and brown colouring matter by combining methylenaphthole or its sulpho-acids with diazobenzole, diazoxylole, diazocumole, diazonaphthaline, or diazomethyle-naphthaline or their sulpho-acids.

1209. Umbrella Frames, *G. Neu.—19th March*, 1881. 4d.

This consists in the use of spring joints for the ribs and stretchers.

1390. Spinning Frame Traveller Rings, *C. A. Snow. —29th March*, 1881.—*(A communication from J. V. Anthony and W. K. Evans.)—(Complete.)* 4d.

This consists of a spinning frame travelling ring made of glass or glazed earthenware or porcelain, and

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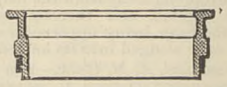

grooved in and around its shank or neck, in combination with a soft metal ring, band, or reinforce arranged in and around the groove.

1476. Producing Designs and Ornamentation upon Artificial Ivory, &c., *R. H. Brandon.—5th April*, 1881.—*(A communication from I. S. Hyatt.)—(Complete.)* 2d.

This consists essentially in the employment, in connection with heat and pressure, of a powdered material and an ink or sizing which is composed of or carries a colour.

2394. Electric Circuits, *S. Pitt.—31st May*, 1881.—*(A communication from Dr. S. Lugo.)* 6d.

This invention is an improvement on the solenoid formed conductor patented on the 15th March, 1881, No. 1119, and is designed to prevent the interferences arising from the action and reaction upon one another of indirect currents. In the present invention the direct and return conductors are formed into a com-

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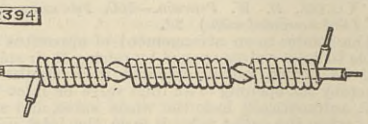

pound solenoid consisting of two or more simple solenoids joined together in series and cross-connected at their junctions. A conducting circuit is thus constructed in which the total resistance of the direct and return conductor is substantially the same, while they may be made of wire of similar thickness. The construction of the conductor will be understood on reference to the figure.

2587. Refrigerating or Ice-making Apparatus, *W. R. Lake.—14th June*, 1881.—*(A communication from G. W. Stockman.)—(Complete.)* 6d.

This relates to apparatus for effecting a continuous circulation of the ammonia in its vaporous or gaseous and liquid conditions by employing the weak or diluted liquid ammonia as an absorbing medium, after it has been reduced in temperature by the use of a weak liquid cooler, and the partially spent vapour from a refrigerator.

2590. Grate Bars for Steam Boiler Furnaces, &c., *W. R. Lake.—14th June*, 1881.—*(A communication from W. U. Fairbairn.)—(Complete.)* 6d.

This relates to a furnace grate consisting of hollow grate bars, the cavities whereof communicate with the ash-pit by openings formed at their front ends, and

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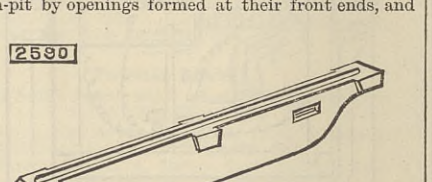

with the spaces between the grate bars at their rear ends by perforations through the sides or walls of the said cavities.

2774. Apparatus for Supplying or Distributing, Utilising, and Measuring Steam, *A. M. Clark.—25th June*, 1881.—*(A communication from B. Holly.)* 6d.

The system consists generally of a battery of boilers placed at a central or convenient point, from which the steam is led in underground main pipes throughout the city, village, or district.

3782. Machinery for Polishing Stone, *J. Liddell. —30th October*, 1875.—*(Not proceeded with.)* 2d.

Two excentric tables in which stones or slabs to be polished can be fixed, are arranged in a suitable framework, and provided with gearing for rotating the two tables in opposite directions and at different speeds, in such wise as by the consequent rubbing face to face of the stones or slabs to polish the latter as required.

4474. Cast Iron or Steel Toothed Wheels, *J. A. Vickers and E. B. Burr.—2nd November*, 1880.—*(Void.)* 2d.

The wheels are so made that they can be fixed upon or removed from a shaft without moving or disturbing the same or any other wheels which may be on the said shaft.

4606. Sewers, &c., *G. E. Waring, jun.—9th November*, 1880. 10d.

This relates principally to the system of sewerage, and consists in a main sewer pipe gradually diminishing in size, and provided with branches, on the ends of which automatic flush tanks are provided, constructed to flush the branches and the main sewer; connecting sewers extending from the sewer pipe or branches into and through the houses, forming an open flue from the sewer to the top, or practically to the top of the house, and air inlets constructed to ventilate the sewers.

5153. Apparatus for the Propulsion of Vessels, *C. O. Rogers.—9th December*, 1880.—*(A communication from W. S. Welton.)* 8d.

This consists in the employment of submerged elastic feathering vertical paddles.

SELECTED AMERICAN PATENTS.

From the United States Patent Office Official Gazette.

244,998. Button Fastener, *Anna E. Kenyon (Administratrix of Martin R. Kenyon, deceased), Providence, R.I., assignor to Union Eyelet Company, same place.—Filed September 15th*, 1880.

Claim.—As an improved article of manufacture, a button fastening, consisting of the flat base or seat A and the tongue B, extending from one end thereof, curved backwardly parallel with the base or seat, and provided with the loop C, as represented, and with the portion F extending beyond the end of the seat, and adapted to be turned over upon the under surface of the end of the base or seat and hooked or clinched

244.998

thereon, substantially as and for the purposes described.

245,011. Trap for Wash Basins, *Andrew W. Nicholson, Brooklyn, U.S.—Filed September 29th*, 1880.

Claim.—The trap A, the inlet pipe B, the outlet

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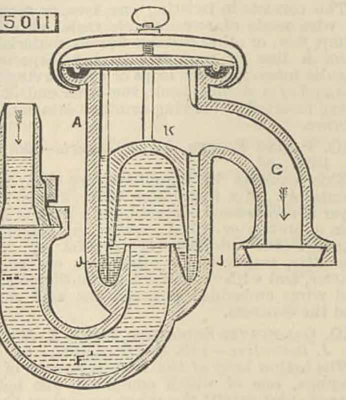
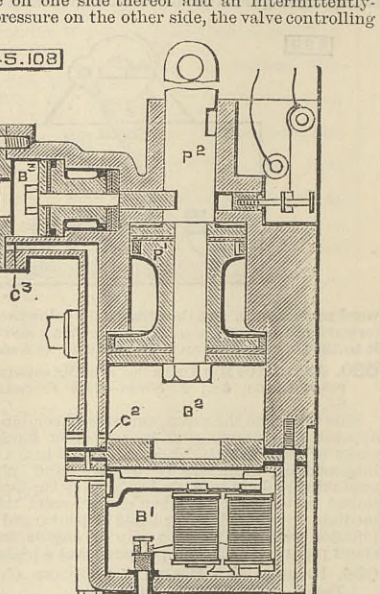


pipe C, the inverted cup K, in combination with the quicksilver seal J, and the water seal F[1] and L, substantially as shown.

245,108. Fluid Pressure Switch and Signal Apparatus, *George Westinghouse, jun., Pittsburg, Pa.—Filed January 6th*, 1881.

Brief.—The locking, unlocking, and movement of the switch or other device is effected through differential pistons having a continuous acting fluid-pressure on one side thereof and an intermittently-acting pressure on the other side, the valve controlling

245.108

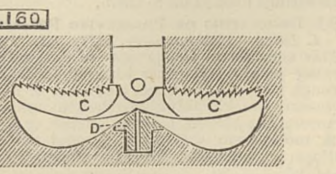


the admission or exhaust of such fluid pressure being operated by electro-magnets. The increased area of the lock-operating piston port causes said piston to move in advance of the switch-operating piston when exhausting or taking fluid pressure. The rod of the locking piston controls a make-and-break mechanism, whereby the appropriate signal is given.

245,160. Expanding Rock Drill, *John Greek and Francis M. Sellman, Evansville, Ind.—Filed March 31st*, 1881.

Claim.—The combination, as hereinbefore described, of the detached cone D, adapted to be placed and held

245.160

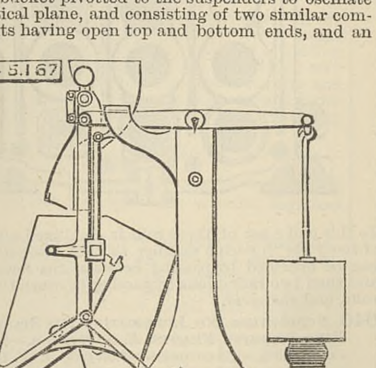


in a socket formed at the bottom of a drill hole, and the bits or arms C C, pivotted to a drill stock and curved in opposite directions, so that when hanging free their points diverge laterally, as shown, for the purpose specified.

245,167. Grain Meter, *John W. Hill, Cincinnati, Ohio.—Filed April 23rd*, 1881.

Claim.—(1) In an automatic grain-weighing apparatus, the combination of suspenders connected at their upper ends with the balance beam of a weighing mechanism, with two independent plates sustained in a fixed position at a suitable distance from each other, a bucket pivotted to the suspenders to oscillate in a vertical plane, and consisting of two similar compartments having open top and bottom ends, and an

245.167

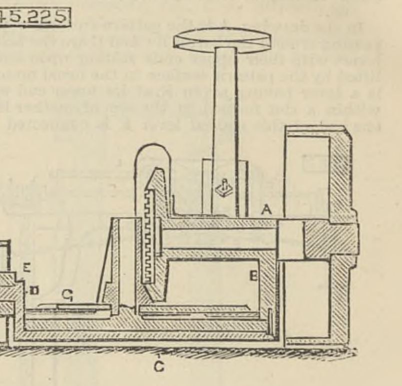


automatic device for locking and unlocking the bucket and suspenders, substantially as described. (2) In an automatic grain-weighing apparatus, the independent plates E[1] E[1], sustained in a fixed position at a distance apart, in combination with an oscillating bucket suspended from the balance beam of a weighing mechanism, and composed of two similar compartments having open top and bottom ends, substantially as described.

245,225. Lawn Mower, *Jas. A. Sanford, Jackson, Mich., assignor of one-half to Jacob Luther, same place.—Filed February 26th*, 1881.

Claim.—In a lawn mower, the combination, with a rotary cutter wheel mounted on a vertical axis, the

245.225



ground driving wheel, and intermediate gearing, o the herein-described frame for supporting said parts, consisting of the sleeve A, standard B, bar C, plate G, upright D, and shaft E, arranged and connected substantially as set forth.

CONTENTS.

The Engineer, September 23rd, 1881.

The New Twin Screw Steamer Tower Hill.—This steamer, which is the second built for the Twin-screw Steamship Company, of Liverpool, made her trial trip on the Firth of Clyde on Friday. The Tower Hill is a steel vessel of 4100 tons, is fitted with twin screws, worked by independent sets of engines, and will carry 5000 tons dead weight of cargo at a speed of about 13 knots. Her length is 420ft., breadth 45ft., and depth 26½ft. She has been constructed to suit both the eastern and western trade, being fitted with punkahs for the east and with heating apparatus for cold climates. The twin screw, as has been shown in her sister ship, the Notting Hill, effects safety and econony. The consumption of fuel by the Notting Hill on her voyage to Calcutta is said to have been 1½ lb. per indicated horse-power, which is the most economical on record. The new vessel has ten of Turner's patent boilers, her crank shafts are made of Vicker's cast steel, and she is fitted with steam steering gear by Harrison, of Manchester. Besides having all the most modern improvements in shipbuilding, the Tower Hill has passed the Admiralty Department for the transport of troops, having eleven watertight compartments, all of which extend to the deck, and can be fitted as a cruiser in the event of war, the boilers and engines being protected by coal armour. On the 'tween decks she could carry 1000 troops. As a trading vessel she can carry 1000 head of cattle. There is accomodation for thirty cabin passengers, but that accommodation could be indefinitely extended. The Tower Hill, which is built on the same lines as her sister ship, the Notting Hill, was built by Messrs. Dobie and Co., of Govan, who have also another vessel of the same description, the Ludgate Hill, on the stocks for the same company. The engines, of which there are two sets, were supplied by Messrs. James Howden and Co., of Glasgow. They are inverted cylinder compound surface-condensing—tandem—the high pressure having a stroke of 32½in., and the low pressure 48in., and can be worked up to a steam pressure of 125 lb. The managing owners of the company are Mr. H. H. Nott and Mr. W. Becket Hill, of Liverpool. The Tower Hill ran over the measured mile three times, and the mean speed obtained was about 14½ knots. It should be added that the propellers were not entirely under water. After the trial had been made, the company sat down to luncheon, which was purveyed by Mr. Forrester, Gordon-street, Glasgow, in the saloon. Mr. Young, of Dobie and Co., presided.