COMPOUND LOCOMOTIVES.

No. I.

On another page we illustrate a Webb's compound engine built for the Companhia Paulista Railway. This engine may be regarded as strictly experimental, as it has been ordered by Mr. Hammond for the purpose of ascertaining whether the compound system will effect an economy in the consumption of fuel, in a region where coal is extremely dear. The occasion seems to be one suitable for opening our pages to a discussion of the merits and demerits of the compound locomotive. It is, however, extremely desirable that before much is said concerning any one type of compound locomotive, the whole subject of compounding locomotives should be fully understood and made perfectly clear. The questions involved are more complex than they appear at first sight. Roughly, they may be thus classified:—(1) Is the compound locomotive more economical in fuel than the simple engine? (2) Is it more economical in repairs? (3) Is it more generally efficient under all conditions of load, fuel, and weather? (4) Does the principle of compounding enable a more powerful engine to be produced than is possible without it? To deal fully with all these questions would be impossible within the limits of space at our disposal, but we can say something concerning them which may tend at least to throw light on them.

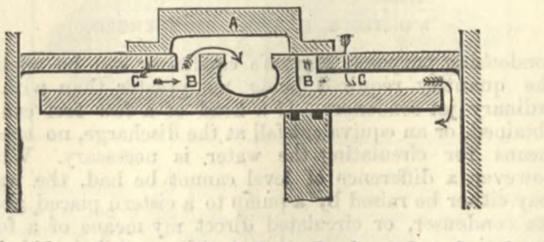
A contemporary, in, on the whole, a thoughtful and temperate article on this subject, stated last week that economy of fuel is quite a secondary consideration, and suggests that the maximum saving to be effected by using compound locomotives cannot exceed about £20 per annum, which is too small a sum to be worth having. This might be quite true if very few engines were in use. On our principal railways, however, locomotives are worked by the thousand, and not by the dozen. A company with 1000 engines under steam daily would save at least £20,000 per annum if each engine saved £20, and this is worth having. It has been estimated that a saving of 5 per cent. in the coal bill of the Great Eastern Railway would make all the difference between a dividend and no dividend on some of its shares; and if £20 per engine may be regarded as a fair return for compounding on engines working through coal districts, at least twice as much ought to be saved on southern lines, such as the South-Eastern, Brighton, or South-Western. Instead, therefore, of economy of fuel being a matter of small importance, it is one to which locomotive superintendents as a body will attach great weight. In dealing with the compound system nothing is easier than to invest it with a certain amount of mystery; and we have heard men who ought to have known better assert that the compound locomotive must be more economical than the non-compound, simply because it is compound. Now, we ought not to have to tell our readers that is simply nonsense, and that it is possible to build and use compound engines which will burn more coal, *cæteris paribus*, than non-compound engines. As regards economy of fuel, it is quite unnecessary to go into any theoretical disquisitions. The simple engine working with the reversing lever in a given notch discharges up the blast pipe at every revolution a given weight of steam of a given pressure. If the compound engine is to be more economical, it must, other things being equal, discharge the same weight of steam at a less pressure. It may be said that the same end will be attained if a less weight is sent up the chimney at the same pressure; but this cannot be the case, or, at all events, it supposes conditions with which compounding is not likely to have anything to do. The whole essence of the compound system as applied to locomotives lies in discharging the steam into the atmosphere with less work in it than is the case with a simple engine. Put in another way, this means that the sensible temperature of the exhaust at the moment it leaves the cylinder must be less than it can be under the same conditions of speed, load, and boiler pressure with the non-compound engine. It may be that even when this lower temperature has been attained, economy has not been secured; but this does not affect the main point, which is that so long as the exhaust temperatures are the same in the compound and non-compound engine, the former cannot be more economical in fuel than the latter. Using this as a crucial test, we find by referring to such diagrams as are available to us that the difference between the compound and the non-compound engine is not very great in the case of fast passenger locomotives. It is very desirable that diagrams taken under varying conditions of load from compound and non-compound locomotives should be published, showing the results of recent practice. Such diagrams, we may add, are very scarce and hard to be obtained. Why, it is not quite easy to see.

It is well known to those who are familiar with railway practice that express passenger trains are run literally as fast as they can go. No more can be got out of the engines than is obtained in moderate weather. On very favourable days there is a small margin on the side of the engine; in winter the use of two engines instead of one becomes all too frequent, if time is to be kept. It so happens that high speeds cannot be attained unless the engines are well linked up. If they are not worked with a high measure of expansion and an early release the back pressure becomes enormous at high speeds. The engines are, to use a quaint drivers' phrase, "smothered." In other words, expansive working is necessary to the attainment of high velocities, and would have to be used even if it entailed a loss instead of a gain in fuel. For this reason it will be found that all high-speed locomotive diagrams have a low release pressure; and this goes to show that for high speeds it does not appear that compounding can do much that the single engine has not done. In the case of goods engines and locomotives working at slow speeds, the conditions are quite different; but we are not dealing with them at present. We do not pretend, however, to assert that it is impossible to get a lower terminal pressure with a compound than with a simple engine; such a statement would be contrary to fact. What we do say is, that in practice the compound engine as now used, especially by Mr. Webb, does not run at very high speeds—such as are usual with express trains—under circumstances of terminal pressure very different from those which obtain in simple locomotives. It is desirable, moreover, that terminal pressures should be lower than they now are, and it remains to be considered whether this end cannot be attained without compounding.

It may be taken for granted that a locomotive engine with two 20in. cylinders, 28in. stroke, four coupled wheels 7ft. in diameter, a boiler with 2000 square feet of heating surface, and 21 square feet of fire-grate, is competent to work the very heaviest and fastest traffic in Great Britain, and have something to spare. With the aid of Joy's valve gear, a pair of 20in. cylinders can be got into an inside cylinder engine. It is close work, but it can be done by, if necessary, cutting holes in the side frames to admit the convexity of the cylinders. It may be taken, however, for granted that such an engine would be too powerful for present requirements. Let us, however, retain the cylinders as they are and reduce the boiler to 1500ft. of surface. If matters ended here, the engines would be found short of steam, simply because the drivers could not be persuaded to work them with sufficient expansion. This is just the trouble Mr. Johnson seems to suffer from with his new 19in. cylinder engines. The boilers are too small for the men in charge of them, not too small for the cylinders.

The only way in which a large cylinder and a small boiler can be satisfactorily combined in a locomotive consists in compelling the driver to work with a large measure of expansion by putting plenty of lap on the slide valve. The result of adopting this plan is, as a rule, unsatisfactory. The engine gets away badly with its train; frequently goes "blind," and has to be reversed before it can go ahead, and, in a word, loses so much time at stations that it is denounced all round. If, however, any means could be devised by which the driver could augment the admission at a station, and not on the road when running, the difficulty would be got over, and simple engines would no doubt give all that can be got from the compound. Various schemes have been proposed. One, for example, is that when the engine is put in full forward gear the feed shall be cut off from the boiler; another, more simple, is that there shall be no notches for full gear forward, and that in consequence the lever can only be retained in this position by an effort on the part of the driver. This plan does not commend itself to anyone, as it might cause dangerous accidents through the flying back of the lever, and is obviously not applicable at all with screw reversing gear. We have before now suggested a method of overcoming the whole difficulty, and it is, we think, worth while to suggest it again.

The accompanying diagram will serve to make our meaning quite clear. It shows a section of a slide valve and steam ports. The valve A is made with so much lap that under no circumstances can steam be admitted for more than 50 per cent. of the stroke. It is clear that under these conditions if one of the cranks stopped on the dead centre the engine could go neither backwards nor forwards, the only cylinder which could take steam being powerless, because the crank proper to it would have no turning moment. In order to get over this difficulty two



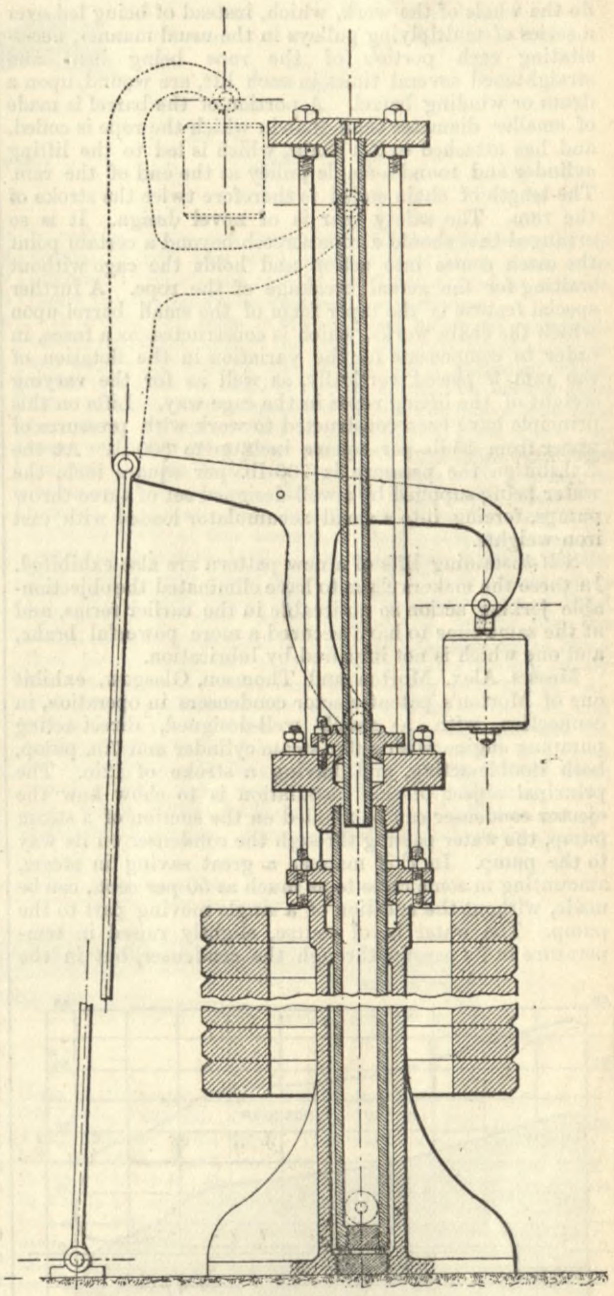
small orifices C C are drilled through the valve face into the steam ports B B. A diameter of about $\frac{3}{16}$in. will suffice. The distance between these holes must be such that both shall not be uncovered by the slide valve at the same time, and no more; that is to say, the valve will be without lap for them. Their mode of operation is very simple. Suppose the engine to stop with one crank on the dead point, then the other crank must stand vertically above or below the crank shaft. When steam is turned on, although both main ports are blinded, the after auxiliary port, if the crank is above the shaft or the forward auxiliary port if the crank is down, will be full open, and the pressure in the cylinder and the boiler will become identical in a moment. The piston will then begin to move, and the engine will start—slowly, it is true, but certainly—until it has turned the other crank off the dead centre, when the engine will proceed just as though it had not great lap. When running fast, the auxiliary ports will be far too small to have any appreciable influence on the action of the steam in the cylinder. Indeed their presence or absence will not be detected on a diagram. It may, perhaps, be said that the holes would be too small to produce any such effect as that we have described. Those likely to argue in this way can have had small experience with 150 lb. steam. It would appear that we have here the true solution of the whole problem how to work steam expansively in locomotive engines, and it is at all events certain that the experiment can be so easily tried, involving, as it does, only the drilling of four small holes, which can, if desired, be readily plugged up again, that it is worth testing in practice.

Assuming that by working engines with more expansion than is now the custom fuel can be saved, we have next to consider whether the money thus obtained can be regarded as all clear gain. We gather from Mr. Webb's experience that pressures of 175 lb. are necessary to success, and we know that these extreme pressures and temperatures are trying to cylinders and valve and port faces. Gland packings are also very troublesome. We do not for a moment say that the difficulties involved cannot be got over. Indeed, we are disposed to say that they have all been got over; but at what cost? In the case of Mr. Webb's engine, which puts itself forward for consideration more prominently than any other just now, we have three cylinders, slide valves, cranks, guide-bars, &c., to lubricate and keep in order instead of two; and the cost for oil will be greater in the proportion of one-third. The same may be said of piston rings and slide valves, as regards renewals and repairs. Furthermore, the Webb compound engine must be very expensive to build. On this point, however, there is no definite information available. Lastly, in this connection we have to consider the amount of net power developed. This is a crucial point; for it is useless to get more power out of an engine if the surplus is all consumed in friction. On this point we have no precise information of any kind. We doubt if anyone has; but it is at least suggestive that Mr. Webb has found it expedient to put larger grates into his compound engines than into any others on the London and North-Western Railway.

We have but glanced at two out of the four questions with which we started. What we have to say concerning the remaining two we must reserve for the present.

MISCELLANEOUS MACHINERY AT THE INTERNATIONAL INVENTIONS EXHIBITION.

In the hydraulic section, Messrs. Stevens and Major's hydraulic balance lift is shown in action. This type of lift, first introduced by French engineers, was at an early date taken up in this country by Messrs. Archibald Smith and Stevens, who from time to time have added improvements, while retaining its special feature, which consisted in balancing the weight of the ram and cage through the medium of a fluid under pressure acting beneath the lifting ram itself, and the consequent suppression of the otherwise necessary overhead weights and chains. In this way the safety of the lift was greatly increased. In the older lifts with rams and overhead balances, the variation in the effective weight of the ram, due to its varying immersion in the water, was compensated by making the balance chains of a suitable weight, in order that as they were paid over from the ascending to the



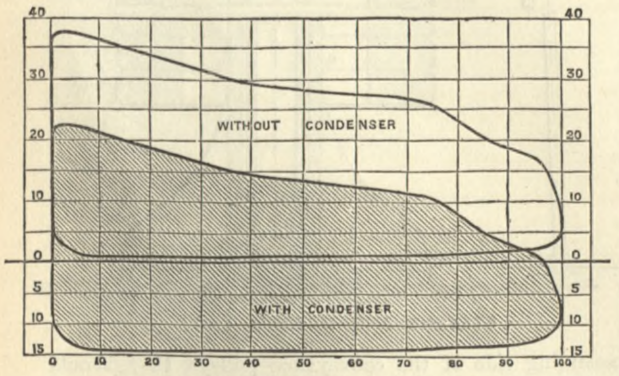
STEVENS AND MAJOR'S LIFT.

descending side of the conveyance pulleys, they should constitute a varying balance according as the flotation of the ram altered. The hydraulic balance lift having no such chains, other means have to be sought for balancing the varying immersion, not only of the lift ram, but of the rams of the balance cylinder itself. The necessity for compensation will be recognised when it is stated that in the case of a lift, now in course of erection, where the useful load to be raised is only 10 cwt., the immersion of the rams, if neglected, would involve an extra expenditure of power equivalent to raising an additional and useless load of $7\frac{1}{4}$ cwt. in every journey, whether the cage was empty or loaded. One method of compensating is by the introduction of additional cylinders and rams working under two different pressures of water, which necessitates the use of internal pistons. Messrs. Archibald Smith and Stevens, however, prefer to make all their lifts with outside packing, secured by ordinary glands, in order that any leakage may be immediately detected. In the lift under notice only two glands are required in the balance cylinder, while only one pressure of water is used, and this may be anything from 25 lb. per square inch to 800 lb., or even more. The result is obtained by attaching to the moving balance ram a pair of three-armed levers, the arrangement being shown in section on page 271. One arm of each lever is pivotted to the crosshead of the ram and travels vertically with it; the second arm is connected by a vertical link to a fixed point—in this case the ground—so that the vertical motion of that end of the arm is prevented; and the third arm carries a heavy weight in such a manner that the latter, while travelling through a curved path, imposes its weight upon the ram crosshead in varying degrees. For instance, when the crosshead is in the highest position, the moving weights are partly supported by the ram and partly by the vertical link in compression, as shown in dotted lines, and are then least effective. At half stroke of the rams, the weights are vertically above the point of attachment to the crosshead, which therefore carries the whole load direct. At the lowest position—shown in full lines—the weights are outside the points of support, and the rams are subjected to the increased pressure due to the action of the lever, taking the fixed link as a fulcrum. It should be observed that the method of compensation here described is not mathematically perfect, but if suitable proportions be adopted, the deviation may be kept within 7 per cent. of the actual amount required—an error which may be neglected in view of the simplicity of the mechanism and the absence of friction. In practice we believe the results are most satisfactory, lifts on this principle having been erected in the Royal Courts of Justice Chambers, the Great Eastern Hotel, and many other buildings in London and other towns.

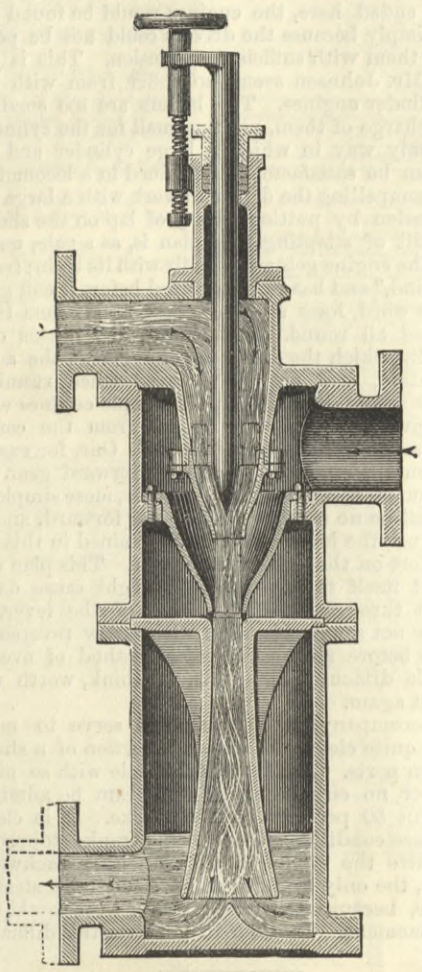
The same firm also exhibits a hydraulic suspended lift, constructed under Stevens and Major's patents, which embodies some features of interest. The designers have again kept in view the desirability of only using rams and packing accessible from the outside. The cage is suspended by two or more wire ropes, each of sufficient strength to do the whole of the work, which, instead of being led over a series of multiplying pulleys in the usual manner, necessitating each portion of the rope being bent and straightened several times in each lift, are wound upon a drum or winding barrel. A portion of the barrel is made of smaller diameter than that in which the rope is coiled, and has attached to it a chain, which is led to the lifting cylinder and round a single pulley at the end of the ram. The length of chain coiled is therefore twice the stroke of the ram. The safety gear is of novel design. It is so arranged that should a rope stretch beyond a certain point the catch comes into action and holds the cage without waiting for the actual breakage of the rope. A further special feature is the taper form of the small barrel upon which the chain works, which is constructed as a fusee, in order to compensate for the variation in the flotation of the ram, if placed vertically, as well as for the varying weight of the lifting ropes in the cage way. Lifts on this principle have been constructed to work with pressures of water from 25 lb. per square inch up to 800 lb. At the Exhibition the pressure is 700 lb. per square inch, the water being supplied by a well-designed set of three-throw pumps, forcing into a small accumulator loaded with cast iron weights.

Self-sustaining lifts of a new pattern are also exhibited. In these the makers claim to have eliminated the objectionable jerking action so noticeable in the earlier forms, and at the same time to have secured a more powerful brake, and one which is not impaired by lubrication.

Messrs. Alex. Morton and Thomson, Glasgow, exhibit one of Morton's patent ejector condensers in operation, in connection with a small, well-designed, direct-acting pumping engine, with a 6in. steam cylinder and 7in. pump, both double-acting, and having a stroke of 12in. The principal object of this installation is to show how the ejector condenser can be applied on the suction of a steam pump, the water passing through the condenser on its way to the pump. In this manner a great saving in steam, amounting in some cases to as much as 50 per cent., can be made, without the addition of a single moving part to the pump. The water is, of course, slightly raised in temperature in its passage through the condenser, but in the



majority of cases this would not be considered a disadvantage, but, perhaps, rather the reverse. The indicator diagram shown above, which was taken from the steam cylinder of the pumping engine at the Exhibition, will serve to illustrate the result which may be attained with the apparatus, and to show the saving in steam that might be effected by its use. In the next column we give a section through the condenser showing its action. In starting, water is first admitted by turning the hand screw and raising the central spindle. The exhaust steam is then turned on, and this meeting the jet of water as it issues from the upper nozzle, is condensed, and carried forward into the discharge nozzle, a vacuum being thereby produced in the condenser and exhaust pipe. Giffard was the first to show practically that high-pressure steam could force water into a boiler against its own pressure, but Mr. Morton was the first to discover that low-pressure steam, such as the exhaust from an engine, could be employed to inject the feed water into a high-pressure boiler; and not only this, but what at first appeared more extraordinary, he demonstrated that steam far below the pressure of the atmosphere when condensed in his ejector-condenser, and producing an almost perfect vacuum, was at the same time capable of discharging the water out of the condenser against the full resistance of the atmosphere. Notwithstanding, however, that the action and merits of this condenser have been known to engineers for a great number of years, we hardly think that steam users generally are aware of its advantages and adaptability to all classes of high-pressure engines; otherwise we believe that Mr. Morton's invention would have received much more extended application than it has done. This was practically acknowledged during the examination which followed on the recent application of the patentee for prolongation of his letters patent, which resulted in an additional seven years being granted. Wherever water is available for

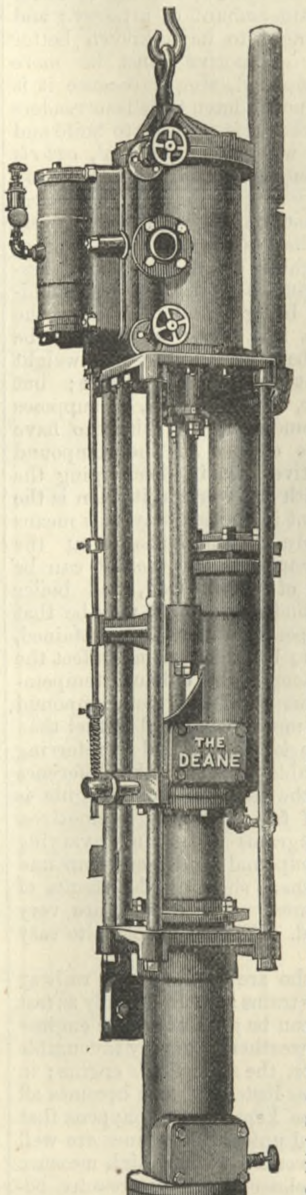


MORTON'S EJECTOR CONDENSER.

condensing purposes, Morton's condenser can be applied, the quantity required being no greater than with an ordinary jet condenser. If a head of a few feet can be obtained, or an equivalent fall at the discharge, no special means for circulating the water is necessary. When, however, a difference of level cannot be had, the water may either be raised by a pump to a cistern placed above the condenser, or circulated direct my means of a force or suction pump, or by the use of a small jet of live steam from the boiler, applied in the condenser itself. It is stated, however, that in no ordinary case is more than one-tenth of the power gained by the condenser absorbed in the circulation of the water. We understand that the ejector-condenser has been applied to almost every class of steam engine, in some cases having replaced the ordinary condenser with air pump. For winding engines it would seem to be specially applicable, because the vacuum is constant whether the engine is at rest or in motion

The production of oxygen and nitrogen from ordinary atmospheric air is shown by MM. Brin Frères, Paris, who claim that by the use of anhydrous oxide of barium they are now prepared to produce pure oxygen gas at a cost sufficiently low to admit of its economical application in many of the industrial arts and manufactures, as well as for some domestic purposes. The process is exceedingly simple. It is one which from time to time has been attempted by various chemists, but it has remained for Messrs. Brin Frères to bring it successfully into practice on a commercial scale. It consists in passing ordinary atmospheric air, deprived of carbonic acid gas, over anhydrous oxide of barium (BaO) heated to between 500 deg. and 600 deg. C. At this temperature the oxygen is taken up by the barium oxide, which is converted into peroxide, (BaO_2) leaving pure nitrogen, which may be collected in any suitable way. When sufficient peroxide has been formed, the temperature is raised to about 800 deg. C. This causes the additional equivalent of oxygen to be driven off, leaving barium oxide. The oxygen is drawn off into a reservoir, and the process may then be commenced again. The apparatus in use at the Exhibition consists of a pump, made by Messrs. F. Pearn and Co., Manchester, which by means of suitable cocks and pipes is employed both in forcing the air through the retorts during peroxidation, and in producing the necessary vacuum during deoxidation; a vessel containing quicklime or caustic soda for depriving the air of carbonic acid gas before it enters the retorts, and a battery of externally heated iron retorts. As the desired changes are only effected at the temperatures above named, it is necessary to regulate the amount of heat with great accuracy. To effect this a special pyrometer has been applied, which by its expansion and contraction is caused to act upon suitable valves, and control the supply of gas and air for heating purposes. In this way reat regularity is obtained, and the working is rendered quite independent of the attention of workmen. MM. Brin Frères state that about 2 lb. of anhydrous barium oxide will produce at the first starting about 1525 cubic inches of oxygen, but the production will increase from day to day, it having been observed that after eight days of continuous work the same weight of oxide produced no less than 4150 cubic inches of the gas. This is contrary to the statements made by Boussingault, Würtz, and others, but the patentees assert most positively that such is the case, and that the anhydrous barium oxide produced by them retains indefinitely its function of abstracting the oxygen from atmospheric air, and giving it off when heated. It is proposed to apply oxygen thus obtained for a number of medicinal purposes, for the preparation of oxygenated waters for table use, for bleaching, for the production of heat in furnaces, and for domestic and other illumination, as well as in a variety of other ways. As regards the nitrogen, the volume of which is of course about four times as great as that of the oxygen, the patentees hope to be able to use it in the preparation of artificial manures, first producing ammonia (NH_3) by synthesis. At the Exhibition a small apparatus in which ammonia is thus formed may be seen in operation. Coal and caustic baryta are thoroughly mixed together, and introduced into a retort heated to 150 deg. C., through which a stream of nitrogen previously moistened with water is passed. The water after being converted into steam is thus decomposed, the oxygen combining with the carbon of the coal, while the hydrogen combines with the nitrogen to form ammonia. Whether such a process as this, or even some modification of it, would be commercially successful on a large scale it is impossible to say at the present moment, but the experiment at least serves to direct attention to what might be a very profitable way of utilising large quantities of nitrogen.

One of the best, and certainly the most varied, shows of pumping machinery is that of the Pulsometer Engineering Company, Queen Victoria-street, E.C., which has been awarded the gold medal. The Pulsometer is, of course, a very prominent feature in this exhibit, and it is shown in operation as applied under several of the many conditions met with in actual practice. This instrument is, however, so well known and largely used that it is unnecessary to enter into any detailed description of its construction or mode of working. For a great variety of purposes it has almost superseded the steam pump, and by its means many difficult sinkings have been accomplished that would have been rendered very costly if other apparatus had been used. Several varieties of the well-known Deane pump are exhibited, among which we may specially draw attention to the double-action sinking pumps, one form of which we illustrate in the annexed engraving. This apparatus has been designed to work when suspended from a chain, and it can therefore be readily let down as the water level is lowered, or be raised out of the way when a shot is fired. It will be seen that the plunger of the upper pump and the barrel of the lower one are fixed, the former being attached to the steam cylinder, while the latter is carried by strong wrought iron rods. In this way the stuffing-boxes, which are both accessible from the outside, are kept at the highest level, so that all grit and dirt falls away from the packing. There are only two valves in the pumps, as the lower plunger, which is about double the area of the upper, discharges the water through the upper pump, one-half going to fill the barrel, while the other is delivered into the rising main. The steam cylinder and valve gear have also special features which are of considerable importance, and which are common to all the Deane pumps of this class. Not the least of these is the great simplicity of the valve gear and the small number of working parts in it, levers, connecting-rods, and rockers being entirely avoided. The supplementary piston, which actuates the main slides, is driven by the direct pressure of the steam, complemented when necessary by the whole power of the main engine, the mechanical connection between the main piston and the valve rendering it absolutely certain that the latter shall always lead, so that while clearance may be reduced to a minimum, there is no chance of the piston striking the covers. Both the up and down strokes are independently controlled by means of throttles in the steam ports, which are also provided with clacks, which open for the admission of steam, but close at a certain period of the exhaust, in order to form a cushion for the piston. It is impossible to describe, or even to enumerate, the many forms in which the Deane pump is produced; but we may mention that special designs are made for boiler feeding; breweries; artesian wells; high-pressure hydraulic work;



air pumps for condensers and for sugar refineries; while the larger sizes, such as are used for waterworks, are compounded and fitted with condenser and air pump. Another form of pumping engine shown is the Duplex, in which two complete machines are arranged side by side, the steam valves of one being actuated by the movement of the piston of the other. When the first pump is at the end of its stroke, the piston-rod of its fellow, by means of a simple swinging lever, moves its slide valve so as to give steam at the other side of the piston, and so reverse the travel. The second pump, when its own stroke is completed, waits for the first pump to give it steam in a similar manner. This apparatus is also made in a great number of different forms, so as to meet the various uses to which it is applied. No expensive foundations are necessary, as the action of the machine is so free from shock or jar that it is frequently placed on an ordinary timber floor. The same firm also exhibits patent filtering machinery for dealing with large or small quantities of water. The Thames filter, which has been designed for filtering muddy water, such as that of the Thames, so as to render it suitable for industrial purposes, has been already fully described and illustrated in The Engineer. Another form, the Air-cleaned filter, which usually contains charcoal as the filtering medium, is suitable for use by water companies. In this apparatus filtration takes place from above, downwards, in the ordinary way, the charcoal resting on a perforated plate covered with wire gauze. When the material has become dirty by use, air is blown through it from below with considerable violence, at the same time that a reverse current of washing water is allowed to flow through. During the disturbance so caused the dirt is freed from the filtering medium, and passes away with the washing water by an overflow. The filter is then ready for use again. Where steam is not available for actuating the blower, an air pump is supplied. Besides the machinery already referred to, the Pulsometer Company shows distilling apparatus for either salt or impure fresh water, softening apparatus for water, and Professor Holmes' Siren fog signals. Enough has, however, already been said to show the generally interesting and comprehensive nature of the exhibits.

ELECTRIC LIGHTING AT THE INVENTIONS EXHIBITION.

On Saturday night Messrs. Paxman and Balls—Messrs. Davey, Paxman, and Co., of Colchester—entertained a number of guests in the Chinese Restaurant of the Inventions Exhibition. The band—and a very good band it is—of the Standard Works, Colchester, played a selection of airs during the dinner. Mr. Paxman occupied the chair. The principal guests were Sir Cunliffe Owen, Sir Frederick Abel, Sir Frederick Bramwell, Mr. Causton, M.P., Mr. Gooch, and others. Mr. John Hammond, who has had charge of the engines and boilers in the electric light shed, as Messrs. Davey, Paxman, and Co.'s representative, and to whom much of the success which has attended the working of the machinery is due, was also present.

This is the third year in which power has been supplied by Messrs. Davey, Paxman, and Co. Each year larger demands have been made on the skill and resources of the firm, and draughts of this kind have always been honoured. This is the third occasion on which the firm have entertained those connected with the Exhibition with whom they have been most concerned; and the dinner of Saturday night was rendered specially interesting by the presence of Sir Cunliffe Owen, perfectly restored by prolonged rest from a tedious illness brought on solely by overwork. His health was proposed by Sir Frederick Bramwell, who expressed a hope that he would be able to lend his powerful aid to the Exhibition to be held next year. Sir Philip Cunliffe Owen, in responding, expressed his gratitude for the sympathy which had been shown him in his recent severe illness. The success of the present Exhibition was mainly due to the exertions of the Executive Council, the members of which had been selected with great discrimination by his Royal Highness the Prince of Wales. With regard to next year's Exhibition, in which his Royal Highness took a great interest, it would be the first occasion on which the mother-country had called upon her children to take part in an exhibition exclusively of their productions, and he trusted that it would be a most successful one, as it could not fail to be attractive. When this series of Exhibitions was first inaugurated it was the desire of his Royal Highness that the Inventions Exhibition should be followed by a Colonial and Indian Exhibition, and in order to give the Colonies time to make suitable preparations the Prince had personally communicated with the authorities of the various colonies in reference to the matter just twelve months ago. The allotments of space which each colony was to occupy had already been made, and he believed that every inch of space so allotted had already been appropriated and would be fully occupied at the opening of the Exhibition on the 1st of May next. The subject had been brought under the notice of the Legislatures of the respective colonies, and he believed that unlimited supplies had been already voted with the object of rendering the Exhibition a valuable and a successful undertaking. In this instance no question of classification would be raised, because each colony would be called upon to classify its own objects in order to prevent a suspicion of rivalry between the different colonies. He trusted that the result of the Exhibition of 1886 would be to draw still closer the bonds which held together this great Empire, of which each part had so much reason to be proud. Several other toasts were proposed before the company separated.

It is universally admitted that the Exhibitions now being held yearly at South Kensington owe their success in a large degree to the electric light. This, in its turn, has depended on the engine power supplied. This year Mr. Paxman's engines have encountered a considerable number of rivals, and we may add from personal experience that they have worsted them all. The conditions are trying. The engines have to run for night after night without stopping for a moment, and this test has been too severe for the high-speed engines, concerning which so much was promised at the beginning of the season. As a practical comment on what was taking place, the incandescent lamps in the Chinese Restaurant, where the dinner took place, nearly went out during the evening, and candles had to be brought in. The current was restored after a lapse of some minutes, but not to its former intensity. Mr. Paxman might well be excused for explaining that his engines did not drive the dynamos lighting the room. Even the electricians have this year made no complaints about the Paxman engine; in fact, they had nothing to complain about, and the public at large visiting the Exhibition are to be congratulated, as well as the Colchester firm, on the success which has attended the labours of the latter.

THE REMOVAL OF FLOOD ROCK, HELL GATE, NEW YORK HARBOUR.

Nine years ago last month the great explosion of 47,781 lb of explosives in 3676 holes bored in the rock under Hallet's Point of the Hell Gate rocks in the New York harbour was effected, and an enormous obstruction to navigation removed. Since that time a similar work has been in progress under Flood Rock. The position of the rock is shown on the accompanying engraving, Fig. 1. Although the work of removing it was commenced in 1875, the American Government method of granting funds for any work is so irregular that great delays have occurred from want of money. It is said that the excavation was virtually finished in 1883, but the failure to grant an appropriation for 1884 compelled the useless expenditure of 30,000 dols. for simply keeping the works intact, and ready for the reception of the explosive now being put in place. The rock is a ledge of gneiss about a quarter of a mile from Hallet's Point, Astoria, L.I. It forms a very irregular obtuse cone, only a small portion of the apex of which comes above water. This formation and its location in the bend of the river almost in the centre of a swift current at each change of the tide make it an object of great dread to pilots. To the contour 26ft. below mean low water it is about 1200ft. by 625ft. in its longest dimensions, and covers an area of somewhat in excess of 9 acres. Operations were commenced by forming an artificial island about the highest portion of the rock. The ultimate limits of this island are shown in Fig. 2 by the line surrounding the shafts. Within these limits shafts have been sunk, and the galleries gradually extended to the desired extreme points. Thus was formed an immense chamber, averaging about 10ft. from floor to ceiling, having a stone roof averaging about 15ft. in thickness, and supported by 467 rugged and massive columns. In this chamber, Fig. 3, running parallel with the East River, are twenty-four galleries, the longest measuring 1200ft., and running at right angles to the stream are forty-six galleries, the longest of which is 625ft. The area covered by the chamber is about 9 acres. The aggregate length of the galleries is 21,670ft. It is the intention of the Government to give a clear depth of 26ft. of water over all the points of rocks indicated in Fig. 1. The shell of rock necessarily left between the galleries and the water varies in thickness from 10ft. to 24ft., as the conditions required. To support this roof there are left 467 rock columns, each about 16ft. square, and varying in height with the galleries. As the experience at Hell Gate proved it more economical to break up the rock and remove it by dredging than to remove the greater part by tunnelling, the officers in charge at Flood Rock under General Newton have only regarded the galleries as means of drilling and charging the rocky shell. As a consequence, 13,286 holes have been drilled into the pillars and roofs of the galleries; these holes will average 9ft. in depth, and in the columns are about 5ft. apart, and in the roof 4ft.; they are 3in. in diameter. The total quantity of rock excavated in driving the galleries, &c., was 80,166 cubic yards; and in the pillars and roofs now standing there is about 275,000 cubic yards more.

The work of honeycombing the rock has been completed, and about 45,000 cartridges containing about 270,000 lb. of explosive put in place, the explosion of which is to be electrically effected to-morrow. The explosives used are rackarock and dynamite No. 1, in the proportion of about eight volumes of the first to one of the last. This rackarock is a mixture of chlorate of potash with dinitro-benzole; these ingredients are harmless in themselves and are delivered separately to the authorities on Great Mill Rock, near the Flood Rock. The operation of charging the cartridge cases was conducted as follows:—The cases were made of thin copper, and were each 24in. long and 2½in. in diameter, each holding 6 lb. of the rackarock. The potash and benzole were mixed intimately in a lead-lined vat, the potash being passed through the meshes of a fine sieve and the benzole then added in the requisite proportions; around three sides of the mixing-room were the men who packed the powder into the cases, each man having a hod-like receptacle before him filled with the rackarock, which has the appearance of a moist light brown sugar; the powder is tamped into the case with light wooden rammers. As each case was filled it was tallied and passed to the fourth side of the room, where a head was soldered into each of the cases filled with 6 lb. of an explosive that has 95 per cent. the strength of dynamite No. 1. The soldering was effected by steam heat, limiting the temperature to about 212 deg., and thus securing a margin of safety between that and the exploding point of the rackarock. As delivered, each case had around its neck a slight coating of a very fusible alloy, and a thin plate covered with the same compound was dropped upon a narrow ledge in the neck of the case, and both then applied for a few moments to the steam-heated cup and the case hermetically sealed. When tested as to weight and duly checked off, the filled cases were deposited in cellular boxes and transported to the galleries. At the bottom of each case were soldered four short brass wires intended to steady the case in the borehole and, as a guide, insure regular contact between any two cartridges.

FIG 1

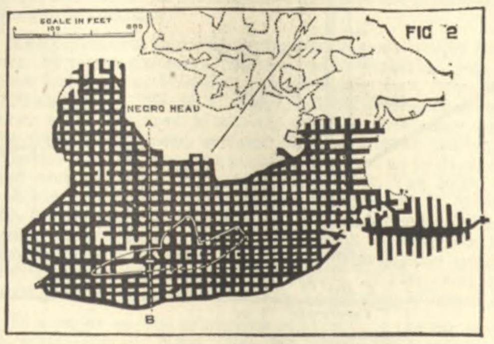


FIG 2

In drilling the holes in the roofs and pillars an exceedingly careful record was kept of the length and direction of each hole, and each when finished was plugged by a numbered wedge, which indicated its location on the charts. In loading these holes, a car was used surmounted by movable frames that could be built up one on the other until the highest parts of the roof were reached. The 6 lb. rackarock cartridges were first inserted. In the Hell Gate explosion each drill hole had its primer and battery wire. The original estimate for "Removing reefs at Hell Gate and Diamond and Coenties Reef" was 5,139,120 dols.; of this amount, 3,136,945 dols. had been expended to June 30th, 1883. This expenditure includes all the work done at the points named since 1868, and current report puts the estimated cost of the completed improvement at Flood Rock at 1,000,000 dols. As to detailed cost, we find from the annual reports of the Chief of Engineers that the cost, at Flood Rock, for removing one cubic yard of rock in a heading 6ft. by 4ft. was about 10 dols., and the stoping cost 4 dols. per cubic yard; this included all charges incidental to the work, and taking the report of June 30th, 1883, as an example, with the heading costing 10,239 dols., the items stand about as follows per cubic yard:—Drilling, 6·652 dols.; blasting, 1·684 dols.; pumping, 0·623 dols.; ventilating, 0·29 dols.; timbering, 0·077 dols.; transportation, 0·132 dols.; surveying, 0·355 dols.; superintendence, 0·687 dols. For stoping the same items cost, taking them in the same order:—2·831 dols., 0·645 dols., 0·273 dols., 0·017 dols., 0·034 dols., 0·058 dols., 0·156 dols., 0·301 dols.; total, 4·31$\frac{5}{10}$ dols. per cubic yard. The cost of a linear foot of 2in. hole, in 1883 report, was, for heading, 0·341 dols.; and for stoping, 0·431 dols.; the 3in. hole cost 0·535 dols. per lineal foot. In a shift of eight hours each machine drilled 22·98ft. of 2in. hole and 19·49ft. of 3in. hole in 1883. The pounds of explosive used per cubic yard of rock broken was, in the 10ft. by 6ft. headings, 3·62 lb.; in stoping, 1·39 lb. The total expenditure for "excavation at Flood Rock," in the year ending June, 1883, was 161,894·02 dols.

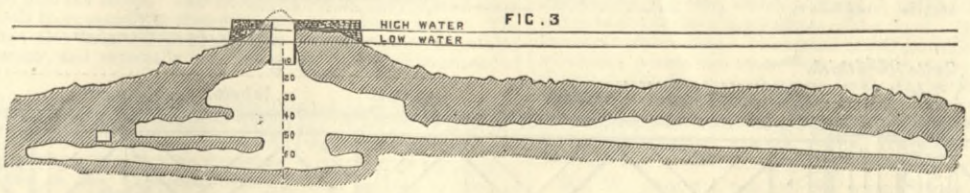


FIG. 3

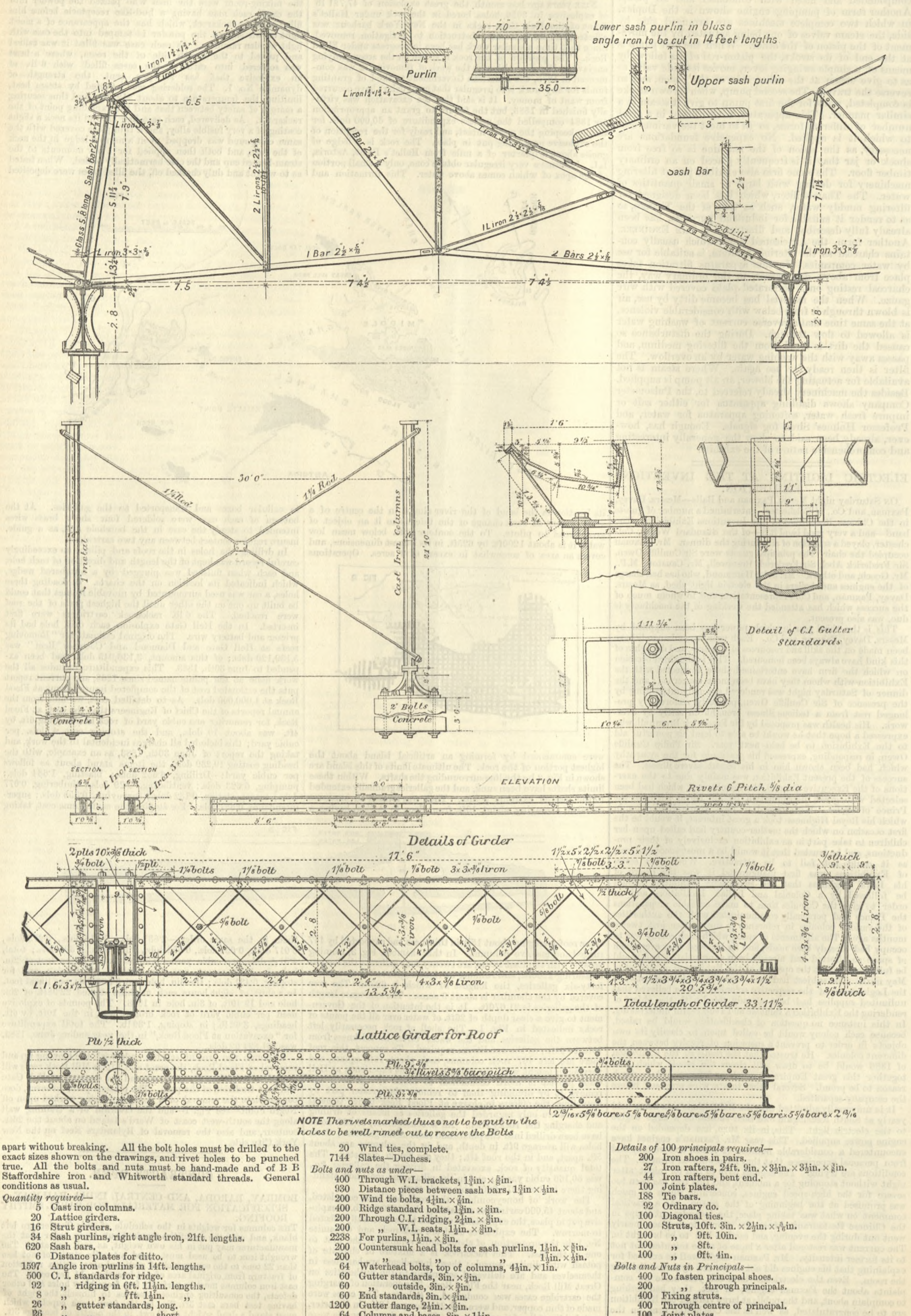
Although the present scheme ends with the blowing up and removal of Flood Rock, the great and Little Mill Rock reefs will doubtless be ultimately removed, and the dangers of Hell Gate will be a tradition of the past. The present plan, however, does contemplate the removal of a rock, now being worked upon off Negro Point—see Fig. 1—and the erection of a training wall along the south-west coast of Ward's Island on about the 26ft. contour, and also the removal of Rylandars Reef on the New York City side.

CONTRACTS OPEN.

BOMBAY, BARODA, AND CENTRAL INDIA RAILWAY.—SPECIFICATION FOR MATERIALS FOR PAREL SMITHY ROOFING.

The columns for weights in the schedule of this Tender are left blank, and only the quantities required put in, in order that the manufacturer may put in his own weight, as well as rates. The wrought iron to be used must stand a tensile strain of not less than 22 tons to the square inch of sectional area, with a reduction of fracture from original area of not less than 14 per cent. The cast iron columns must be perfectly free from blow holes and other defects, the consulting engineer reserves to himself the right of having test bars cast 3ft. 2in. by 1in. from each cupola, which must stand a dead weight of 30 cwt. in the centre on bearings 3ft.

CONTRACTS OPEN.—SMITHY ROOF, CENTRAL INDIA RAILWAY.



apart without breaking. All the bolt holes must be drilled to the exact sizes shown on the drawings, and rivet holes to be punched true. All the bolts and nuts must be hand-made and of B B Staffordshire iron and Whitworth standard threads. General conditions as usual.

Quantity required—

5	Cast iron columns.
20	Lattice girders.
16	Strut girders.
34	Sash purlins, right angle iron, 21ft. lengths.
620	Sash bars.
6	Distance plates for ditto.
1597	Angle iron purlins in 14ft. lengths.
500	C. I. standards for ridge.
92	,, ridging in 6ft. 11½in. lengths.
8	,, ,, 7ft. 1½in. ,,
26	,, gutter standards, long.
26	,, ,, ,, short.
76	,, gutters in 7ft. lengths.
4	,, ,, 2ft. 9in. ,,
4	,, ,, 3ft. 9in. ,,
20	Wind ties, complete.
7144	Slates—Duchess.

Bolts and nuts as under—

400	Through W.I. brackets, 1¾in. × ⅝in.
930	Distance pieces between sash bars, 1¾in × ½in.
200	Wind tie bolts, 4½in. × ⅞in.
400	Ridge standard bolts, 1¾in. × ⅝in.
200	Through C.I. ridging, 2¼in. × ⅝in.
200	,, W.I. seats, 1½in. × ⅜in.
2238	For purlins, 1½in. × ⅝in.
200	Countersunk head bolts for sash purlins, 1¾in. × ⅝in.
200	,, ,, ,, 1½in. × ½in.
64	Waterhead bolts, top of columns, 4½in. × 1in.
60	Gutter standards, 3in. × ¾in.
60	,, outside, 3in. × ¾in.
60	End standards, 3in. × ¾in.
1200	Gutter flange, 2½in. × ⅝in.
64	Columns and bases, 8in. × 1½in.
64	Girders and columns, 3¾in. × 1½in.
64	Strut girders do. 2¾in. × ¾in.
320	Coupling plates, 2¾in. × ¾in.

Details of 100 principals required—

200	Iron shoes in pairs.
27	Iron rafters, 24ft. 9in. × 3½in. × 3½in. × ⅜in.
44	Iron rafters, bent end.
100	Joint plates.
188	Tie bars.
92	Ordinary do.
100	Diagonal ties.
100	Struts, 10ft. 3in. × 2½in. × 5/16in.
100	,, 9ft. 10in.
100	,, 8ft.
100	,, 6ft. 4in.

Bolts and Nuts in Principals—

400	To fasten principal shoes.
200	,, through principals.
400	Fixing struts.
400	Through centre of principal.
100	Joint plates.
100	Cotters.
100	Jibs.

Tenders to be in 13th October, 1885.

RAILWAY MATTERS.

The works of the Indian Midland Railway, the funds for which were recently subscribed in London, will be begun immediately.

The Board of Trade report on the fatal explosion of a locomotive boiler in July last, at Messrs. Kirk Brothers' Works, Workington, ascribes the explosion to grooving of the plates along longitudinal seams, want of proper inspection, and to fixed down safety valves.

An American paper says:—"Trains stop to let off and take on passengers, on the elevated railways in New York city, average seven seconds only. On the Metropolitan underground road in London they average eighteen seconds, taken from 200 observations."

The Union Pacific Railway, under military protection, has set the Chinese labourers to work again at Rock Springs, Wyoming, in the collieries. Some of the whites are working with them. Others who have declined to do so have been paid off and ordered to quit the place. This plan, which the Federal officials approve, is being peacefully carried out. General Schofield, commanding the Department, has gone to Rock Springs to represent the Government.

The Russian papers announce that the section of the Transcaspian Railway from Kizil Arvat to Askabad is almost complete, and that it may be expected to be formally opened at an early date. They are also asking whether the line is to stop at Burdalik, its ultimate destination on the Amu Darya, or whether it is to be carried beyond that place. A commission, composed of members of the different departments, has been appointed to investigate the subject.

The great majority of German locomotive superintendents decidedly favour bushes for connecting and coupling rods, instead of strap ends. Red brass and phosphor-bronze is used for these, and when worn they are lined with white metal. Advantages claimed are greater simplicity of construction, greater security in keeping the correct length of rods between pin centres, rarer heating, greater durability, and easier and cheaper maintenance—a formidable list, with what an American contemporary considers some rather unexpected items.

The Canadian Pacific Railway is being pushed rapidly towards completion, and the officials are confident that the road will be finished and the ends connected by the 20th of this month. Last Saturday night the eastern track had reached a point twenty-four miles west of the summit of Selkirk's, and 2511 miles west of Montreal. The western track was being more rapidly laid, and had reached a point 334 miles to the east of Port Moody, leaving then unfinished a gap of only fifty miles. The *Toronto Globe* says that the road will not be opened for traffic till next spring.

Three hundred men are working at the pier at Michaelovski bay, connected with the Central Asian Railway. Twenty versts of the railway are completed from Kizil Arvat, and fifteen are ready for the rails. The earthworks are prepared from Kodtchi to Bahrezan. Four thousand two hundred men are at work on the railway. The Government continues to engage more labourers. Private information from Askhabad states that the rails on the Central Asian line have been laid as far as Bami, fifty versts from Askhabad. The earthworks are completed to Sarakhs, and the preliminary works as far as Merv.

The report has been issued for the year 1884 of the New South Wales Commissioner for Railways. Concerning the railways the report shows that the gross receipts for the year amounted to £2,086,237, and the working expenditure to £1,301,259, or 62·37 per cent. of the earnings. The net earnings were £784,978, yielding 4·20 per cent. upon the capital invested in the lines in operation—1618 miles. The total earnings of the tramways during the year were £219,942, an increase of £29,243 over the earnings of 1883. The expenditure was £215,167, and the net earnings £4775, giving upon the capital invested a return of only 0·76 per cent. With the view of reducing the cost of wear and tear, the engineer for existing lines had suggested that the permanent way should be relaid upon a new system.

Of the railways of New South Wales, which are the property of the Government, the Southern line is in operation from Sydney to Albury, a distance of 384 miles, where it becomes connected with the line from Wodonga, on the opposite side of the Murray, to Melbourne. Branches from this line run to Jerilderie and Hay. The Western line, which crosses the Blue Mountains, is now open to Bourke, on the river Darling, 503 miles from Sydney; while the Northern line, from the important seaport of Newcastle, is being continued from Glen Innes, 373 miles from Sydney, to the Queensland border. It has a branch to Narrabri, 327 miles from Sydney. There are also suburban lines from Sydney to Hurstville, Parramatta, Richmond, and Windsor, which make access to the country around the metropolis cheap and speedy.

The great bridge being constructed across the Parramatta river at Ryde, between Homebush and Waratah, is now far advanced towards completion, and is expected to be ready for traffic by March next. This splendid work will consist of four lattice main girders 478ft. long in pairs continuous over three openings, each having a span of 150ft., and the whole forming six spans across the river, intended to carry a double line of railway of 4ft. 8½in. in width. The lattice main girders will be 25ft. apart in the clear, with cross girders, having longitudinal beams under the lines of rails. The piers, five in number, each consist of two cast iron cylinders, 11ft. in external diameter for the lower parts, and reduced to 9ft. for the upper, by tapering pieces 9ft. in length. Six other wrought iron bridges are to be constructed along the same railway.

The accidents in the United States during August last are classed as to their nature and causes as follows by the *Railroad Gazette*:—Collisions: Rear, 23; butting, 11; crossing, 4; total, 38. Derailments: Broken rail, 1; broken switch rod, 1; broken bridge, 4; spreading of rails, 2; broken wheel, 1; broken axle, 6; broken brake beam, 1; accidental obstruction, 2; cattle on track, 6; land slide, 2; wash out, 5; misplaced switch, 5; open draw, 1, malicious obstruction, 1; unexplained, 12; total, 50. Other accidents: broken excentric strap, 2; broken parallel rod, 2; total, 4. Total number of accidents, 92. Five collisions were caused by trains breaking in two; three by misplaced switches; one each by a mistake in orders, by a runaway car, by a car left standing on main track and by carelessness in leaving cars projecting over on main track from a siding. Of the four broken bridges, two were ordinary wooden trestles; of the other two nothing could be definitely stated except that both were wooden bridges, and one of them had been standing a long time.

German experience gives preference to stay bolts over bars for the tops of fire-boxes, where the tube sheet ring is of well rounded form and the first row of bolts is put in as far as practicable from the tube sheet. The preference is chiefly on account of greater ease in keeping fire-box tops clean. It is recommended that the first row of bolts from the tube sheet should be removable. The *Railroad Gazette* also observes that it also decidedly favours copper for fire-boxes, and gives following specification for the material for that purpose:—(1) To have a smooth surface without cracks, bubbles or scales and to be homogeneous, best refined material, free from foreign matters. (2) The plates must admit of being bent, either hot or cold, to such form as required without showing cracks or scales. Bars ½in. wide cut out of the same, and with the corners rounded off, must allow of folding together hot or cold through 180 deg. without showing cracks. (3) Tension test with pieces cut off in the direction of rolling should reach at least the following figures: Extension between marks., 200 mm.—8in.—apart, 35 per cent.; tensile strength, 31,000 lb.; percentage of area of rupture to original area, 40 per cent. (4) The surface of rupture to appear fine grained and bright, with the peculiar pale red of good copper.

NOTES AND MEMORANDA.

In London last week 2516 births and 1251 deaths were registered. The annual death rate per 1000 from all causes, which had been 15·7 and 13·8 in the two preceding weeks, rose again last week to 16·0. During the thirteen weeks ending last Saturday the death rate averaged 18·1 per 1000 against 20·0 in the corresponding periods of the nine years 1876-84.

An instrument for ascertaining the distances of points accessible or inaccessible has been invented by Dr. Luigi Cerebotani, a professor of the University of Verona. It consists of a pair of telescopes mounted on a tripod stand. Both the telescopes being brought to bear on the object, a reading is taken from a graduated scale on the instrument, which, compared with a set of printed tables, gives the distance.

Leather belt cement, the American *Mechanical Engineer* says, is made by soaking six ounces best glue in one pint of ale; then boil. Add one and a-half ounces of boiled linseed oil, and stir well. Another is to take dissolved glue as patternmakers use it, and add tannic acid till creamy and ropy. Make the leather surfaces to be united rough, apply the cement hot, let it cool and dry under pressure, and it will not need rivetting.

The Barrier Ranges county, in New South Wales, is proving one of the richest metalliferous districts in the world. In addition to the numerous discoveries of silver, there has lately been found an immense ironstone lode at least twelve miles in length and 400 yards in width. The Corona station, on which the lode was found, is seventy miles north of Silverton and practically on new country, thus proving the enormously rich mineral character of this part of the colony.

At the Royal Observatory, Greenwich, the mean reading of the barometer last week was 29·65in.; the highest reading was 29·84in., on Monday and Friday mornings, and the lowest 29·31 on Wednesday afternoon. The coldest day was Sunday, the 27th ultimo, when the mean was only 49·5. Rain fell on six days of the week, to the aggregate amount of 0·52in. The duration of registered bright sunshine in the week was 16·6 hours, against 28·7 hours at Glynde Place, Lewes.

The number of miles of streets which at present contain mains constantly charged, and from which constant supply can be given, and upon which hydrants for fire purposes could be fixed, in each district of the metropolis, is as follows:—Kent, about 85 miles; New River, about 236; East London, 180; Southwark and Vauxhall, 160; West Middlesex, 94; Grand Junction, 78; Lambeth, 203; Chelsea, 72½; making a total length of about 1108½ miles. The companies are ready to give constant supply, and to affix hydrants whenever legally required to do so.

In an article on the motions of camphor on the surface of water, by Mr. T. Hart—*Chemical News*, 51—it is mentioned that Cassamajor attributes these motions to the facts that the specific gravity of camphor is lower than that of water, and that camphor is soluble in water. The author considers both these improbable as causes of the phenomenon, and suggests the following explanation. The cohesion of camphor being small, and its adhesion for water being great, camphor tends to spread itself over the surface of the water; in doing so the particles are kept in constant motion, and they in their turn give motion to the mass. Experiments are adduced in support of this suggestion, and substances with similar properties—such, for instance, as collodion—are observed to behave in a similar manner.

The crystalline form of quartz grains in some sandstones has been seen by many observers, while especial attention was called to these forms in the Wisconsin sandstones, by Rev. John Murrish, in 1870 and later. Mr. H. C. Sorby, in 1880, showed that such crystal forms were produced by the deposition of secondary quartz upon the irregular rounded surfaces of worn quartz grains. For the Wisconsin sandstones, the subject was taken up by Rev. A. Young, and later by Messrs. R. D. Irving and C. R. Van Hise, who have published an extended and valuable paper—*Bull. U. S. Geol. Surv.*, No. 8—with full illustrations, relating to the enlargement both of quartz and felspar grains; recent authors conclude that their results prove that most, if not all, of the ancient quartzites, as well as many of the quartziferous schists, are composed in the main of fragments cemented together by a secondary siliceous cement.

In a paper on the sulphurous anhydride in the air of towns, by G. Witz—*Compt. Rend.*, 100—the existence of sulphurous anhydride as a normal constituent of the air of towns is shown, as described by the *Journal of the Chemical Society*, by the fact that placards coloured with red lead, posted in situations where they are protected from the sun and rain, become gradually decolorised, whereas similar placards exposed under similar conditions in country air retain their colour unimpaired. The decolorised placards are found to contain lead sulphate and lead sulphite, the lead dioxide in the red lead having been converted into the former, and the monoxide into the latter. This decolorisation of the red lead takes place much more rapidly in shop windows where gas is burnt. The author has also frequently been able to recognise sulphurous acid in hail, snow, and especially hoar frosts, in the neighbourhood of towns.

In a paper in the "Proceedings" of the Institution of Civil Engineers on "The Effect of the Drought of 1884 upon the Pollution of the River Thames below London," Mr. R. W. Peregrine Birch, referring to a former paper in which he described a method of calculation now known as the "chlorine method," used by him in 1882 to determine the rate at which the metropolitan sewage is carried away by the river, and the extent of the sewage pollution, gives an account of observations made during the drought of 1884. The following conclusions are arrived at:—All the fresh water and sewage which had entered the river between Teddington and Southend since June 25th was still there on September 8th, and that which entered on June 16th was still there on August 30th. The sewage had remained in the river forty-five days, and the fresh water occupied seventy-five days for its passage from Teddington Weir to Southend. There was less fresh water and more salt water in the river than in September, 1882, and the foul mixture travelled seawards at a much slower rate. The calculations also show that though in time of drought there is more sea water in a tidal estuary than in a wet season, its circulation is so slow that its effect as a diluent is greatly reduced. The circulation in November, 1882, a time of flood, was nearly three times as great as in August, 1884, a time of prolonged drought.

Despite the low price of copper, the copper mining industry of New South Wales continues to make satisfactory progress. During the past year the Great Cobar Company raised 21,561 tons, and smelted 23,879 tons, yielding 2769 tons fine copper. At the end of the year the company had at grass 1000 tons 10 per cent. ore, 5000 tons 8 per cent. ore, and 2232 tons 5 per cent. ore. Up to the end of 1884 the company had smelted 122,795 tons of ore, the average yield from which was 13·17 per cent. of fine copper. Thy Nymagee Company raised during the year 14,748 tons of ore, and smelted 14,743 tons, yielding 2207 tons of fine copper. Up to the end of 1884 this company had smelted 37,650 tons of ore, the percentage of which averaged 15·73, the width of the lode being from 4ft. to 12ft. The New Mount Hope Mine has put out 6149 tons 20 per cent. ore, 1426 tons 12 per cent. ore, and 757 tons 6 per cent. ore, and has smelted 1258 tons fine copper, valued at £54,000. The shaft is 340ft. deep, the deepest level 270ft., and the width of the lode from 10ft. to 50ft. The Great Central Company raised 2221 tons ore, and made 336 tons fine copper, valued at £14,784. The company have seven shafts, varying in depth from 82ft. to 206ft. deep; the deepest level is 150ft., the lode varying in width from 1ft. to 13ft. The Cheshire copper mine at Cudgegong shows a shoot of ore 46ft. wide, yielding 8 to 10 per cent. copper. At Blayney a new copper lode 2ft. in width has been found within one mile of the town, containing grey ore, which by assay appears to be rich.

MISCELLANEA.

A deposit of cobalt, which is likely to become a permanent industry, is being worked near Bungonia, New South Wales, about 120 miles from Sydney.

The Board of Trade report on the fatal explosion of the boiler in the yacht Magnet, of Ipswich, belonging to Mr. J. G. Lyne, in June last, ascribes the explosion to undue pressure and overloaded safety valves.

Six iron and steel passenger steamers for India have recently been sent out by Mr. Edward Hayes, launch builder, Stony Stratford, to work on the Irrawaddy; one stern-wheeler, and five twin screw steamers—size, 70ft. long by 14ft. beam.

The owner of the American yacht Puritan does not seem much in love with his craft. She was put for sale on Wednesday, September 23rd; the highest bid by an outsider was 13,250 dols. or £2850. Mr. Burgess bid 13,500 dols., and she was knocked down to him; no one seemed to want her enough to bid anywhere near her cost price.

The contract for sinking the Oval shaft and boring the two wells for the new waterworks of the Southampton Corporation at Otterbourne has been entrusted to Messrs. Le Grand and Sutcliffe, of London, who sunk the two Arial 12in. tube wells last winter. The supply anticipated is about 3,000,000 gallons per day. This firm is also at the present moment engaged upon sinking the wells for the town waterworks of Alnwick and Farnham.

Messrs. Hansell and Co., of the Canal Steel Works, Sheffield, have obtained a silver medal for their exhibits at the Mining Exhibition held at Glasgow in connection with the visit of the Iron and Steel Institute to that city, consisting of all classes of steel goods, particularly adaptable for mining purposes, such as wheels and axles, haulage pulleys and rollers, tooth gearing, Hansell's registered crown wagon wheels, special cast steel in bars for smiths', miners' use, &c., files, hammers, and such like.

The New York *Sun*, in its issue of September 21st, said: "American skill found no difficulty in building a yacht to beat the Genesta; why should it find trouble, when it has fair play, in building a cruiser to beat the Esmeralda?—an English cruiser." The American *Mechanical Engineer* says: "We would like to make a bargain with the *Sun*. If it will find a way to keep politics out of professional business, we will agree to find American engineers who will build a cruiser that will beat the Esmeralda. Is it a bargain?"

According to a United States contemporary, the Americans are building some large schooners. It is mentioned that the 1400-ton four-masted schooner, Heraldine, built by N. Porter Keene, of North Weymouth, Mass., for Capt. George B. Hussey, of Providence, R.I., has been chartered at Melbourne, Australia, to carry a cargo of canned mutton, &c., to London, England. She is the largest schooner ever built, excepting the five-masted barkentine, David Dows, 1500 tons, constructed by Bailey Brothers, at Toledo, Ohio, three years ago.

The drainage of the parish of Chingford has for some time occupied the attention of the Local Sanitary Committee and of the Epping Rural Sanitary Authority. A large building estate has recently been developed, and the owner has done all he can to make the arrangements of the houses complete, and he is threatened with an injunction for creating a nuisance by an overflow of sewage from the houses already occupied. The proprietors of the Royal Forest Hotel are also threatened with an injunction by the Corporation of London for discharging sewage on to the forest.

The indications that New South Wales is destined to become one of the great silver producing countries of the world are steadily on the increase. The recently published Report of the Mines Department in New South Wales informs us that during the past year a lode or lodes were found at Melrose, containing galena, carbonate of lead, sulphate of lead, and a small percentage of arsenical silver ores, but with the exception of a pit 10ft. square, little work has been done. An assay of the galena gave 136 oz. of silver per ton. An assay of the carbonate of lead gave 58 oz. 16 dwt. of silver, besides lead and copper.

It would be difficult to say who made the first iron plough, but in Scotland, a contemporary says, "the inventor was a humble Scotch blacksmith named William Allan. His modesty was so great that after he made his first plough, and it did satisfactory work on his own farm, he declined to make a second for neighbouring gentlemen, on the plea that he was not as good a blacksmith as the gentlemen ought to have, and recommended a neighbour of his named Gray. The latter became rich at the business, while Allan remained as poor as ever, though before his death his style of plough was in use all over the United Kingdom."

Pittsburg, U.S., made holiday on Tuesday. The citizens were celebrating the opening of the Davis Dam, on the Ohio river, six miles below the city, which is designed to give an ample depth of water in the harbour in all states of the flood. It has cost £200,000 to construct the dam. It consists of 300 movable dams, or wickets, extending across the river—there 1233ft. wide—each hinged so that it can lie flat upon the river bed. The central lock provides a passage for steamers. The dam is to be used when the water is low. The wickets are folded down when the water is high. This is an experimental system, which, if successful, will be used throughout the Ohio river, making it almost continuously navigable.

Mr. W. Asquith, machine tool manufacturer, Halifax, has just sent two fine tools to the works of Messrs. Yarrow and Co. One is a 30in. centre treble-geared brake lathe, to turn up to 10ft. diameter and 6ft. wide in the brake. The loose, or sliding bed, is 28ft. 6in. in length, and weighs upwards of 10 tons, and is fitted up with two carriages weighing 65 cwt. each, which are self-acting and surfacing by back traverse shaft, and screw cutting by screw placed inside of the bed. The carriages can be worked independently or simultaneously. The lathe is calculated to execute the heaviest class of work that can be put to a general lathe, and weighs complete about 40 tons. The other is a radial drilling machine with 6ft. radius, which we shall illustrate at an early date.

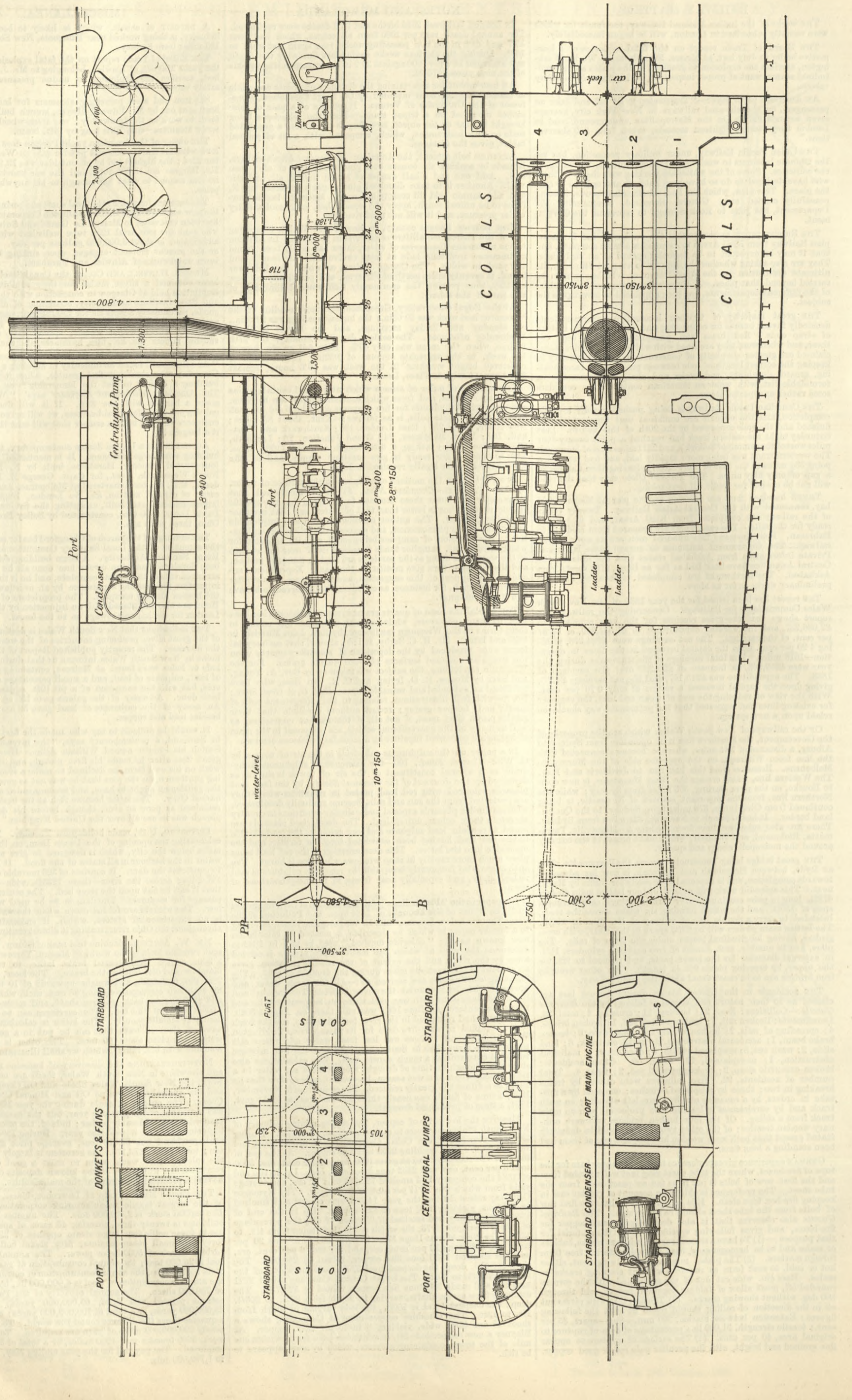
Notwithstanding the discovery of kerosene shale at Capertee and elsewhere in New South Wales, there are only two mines at work, the New South Wales Shale and Oil Company at Hartley, and the Australian Kerosine Oil and Mineral Company at Joadja Creek. The output of shale during the year 1884 was somewhat less than that of the previous year, but the average price per ton realised was considerably higher; indeed, the price has not been so high since 1880 as it was last year. During 1884 the quantity of shale produced was 31,618 tons, average price £2 5s. 7·86d. per ton; total value, £72,176. As kerosene is largely used throughout the colony, there would seem to exist a good opening for the remunerative utilisation of the known deposits of shale by those having a practical knowledge of the mannfacture.

The Pacific Mills, situate at Lawrence, Mass., are reported to be the largest textile manufacturing corporation in the world. The capital stock is 2,500,000 dols. The number of the mills and buildings is twenty-three, covering 43 acres of space; there are in use in these mills four large steam engines of 3500-horse power, forty-two small steam engines, fifty steam boilers, and eleven turbine wheels of 5000-horse power. The annual consumption of coal is 25,000 tons; the annual consumption of gas in 9000 burners costs 35,000 dols., the annual consumption of cotton is 15,000 bales, the annual consumption of wool is 4,000,000 lb., being the product of 750,000 sheep. The annual capacity of the Pacific Mills is, in cottons printed and dyed, 65,000,000 yards; worsted goods, 35,000,000 yards, or a total of 100,000,000 yards; equal to two and a-quarter times the distance round the world. To make this cloth, nearly 200,000,000 miles of yarn are required. To accomplish this work, 3600 females and 1900 males, or a total of 5500 persons, are employed. The pay roll for the year ending May, 1884, amounted to 1,790,000 dols.

THE ANTWERP EXHIBITION—GENERAL ARRANGEMENT OF ENGINES AND BOILERS OF THE PHLEGÉTON.

LA SOCIÉTÉ ANONYME CLAPAREDE, ST. DENIS, FRANCE, ENGINEERS.

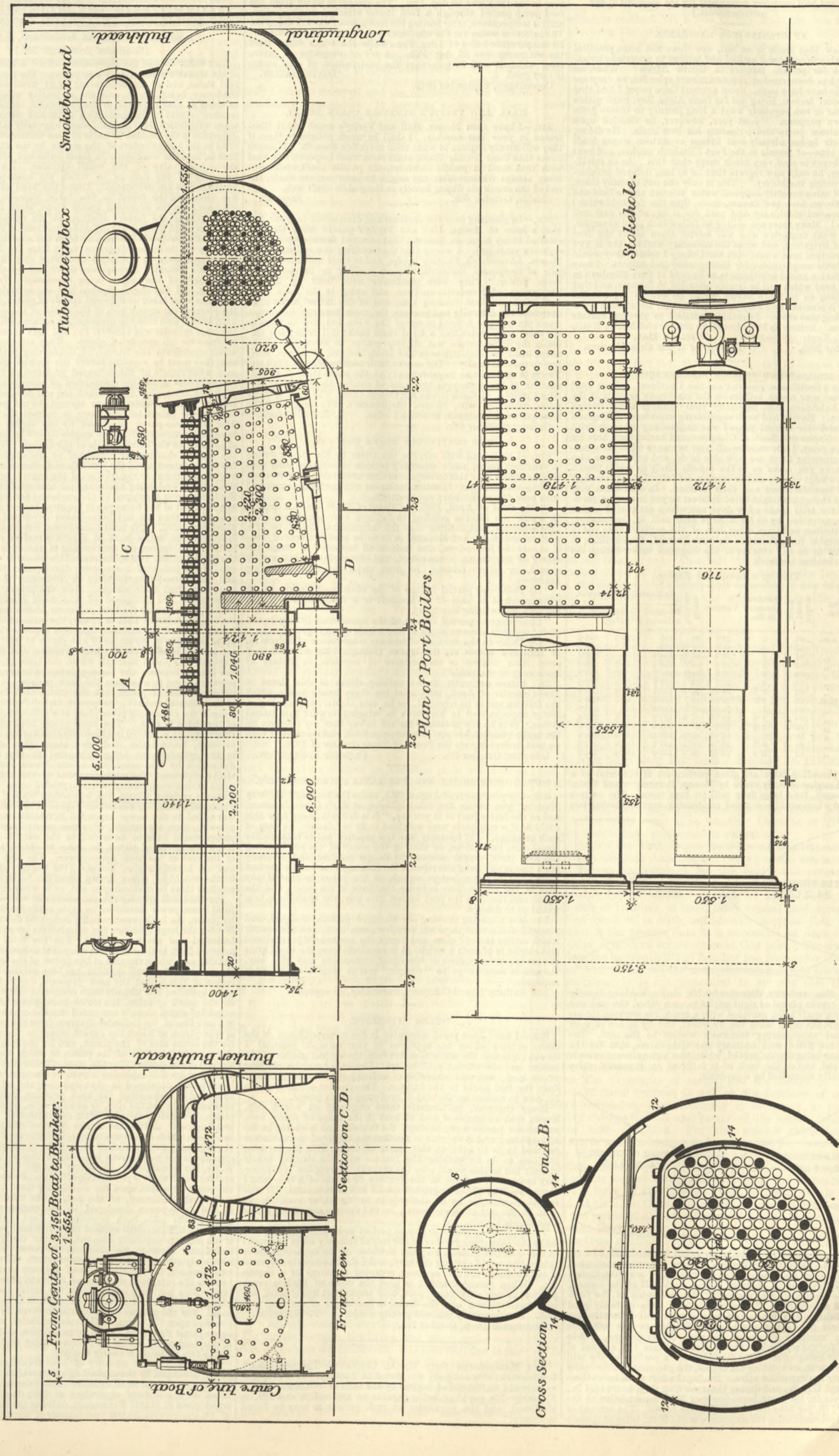
(For specification see page 283.)



THE ANTWERP EXHIBITION—BOILERS OF THE FRENCH WAR VESSEL PHLEGETON.

LA SOCIÉTÉ ANONYME CLAPAREDE, ST. DENIS, FRANCE, ENGINEERS.

(For description see page 283.)



LETTERS TO THE EDITOR.

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

AN OPENING FOR ENGINEERS.

Sir,—Now that trade is so bad, are there not some practical engineers able to command capital and willing to undertake irrigation works for private farmers in South Africa? Wherever machinery has been erected the returns are splendid, as they are where wells have been sunk. From a recent Cape paper I find that a Humansdorf farmer, living not far from Algoa Bay, until within the last year or two regularly went a long journey to obtain grain for his own purposes. "Last year, however, he decided upon having a steam pump and irrigating his own lands. He did so, and this year he has already sent fifteen or sixteen wagon loads —48 or 50 tons—of cereals to the Port Elizabeth market, and next season he hopes to send very much more than this. As an intelligent farmer, he only now regrets that he so long delayed purchasing and erecting machinery." This is only one out of many cases. A friend of mine recently supplied water to some arable land and let it for 20s. an acre per annum, more than the freehold value! Another erected machinery and paid for it out of the first irrigated crop! Many more are willing to follow such good examples, but they want engineers who will advise them about the best methods of irrigation, and erect the necessary works; and if two or three practical men would visit the Colony I believe they would find profitable employment for their money and talents. I may mention that a grand exhibition is to be held at Port Elizabeth in December next which will be largely attended by farmers, and that any intending to take my advice would do well to leave in the middle of November and stay in Port Elizabeth for at least a few weeks during that show. I should be pleased to give any further information. Letters to be addressed to me, care of Mr. C. Ryall, Orpington, Kent.

William Hay,
Late editor of the *Cape Mercury*.

September 28th.

ENGLISH AND FOREIGN STEAM ENGINES.

Sir,—As a Scotchman resident on the Continent, I have read with interest your recent articles on the machinery exhibits at the Antwerp Exhibition, and especially your remarks about foreign competition. Having had some engineering experience in England and Scotland—for several years I was engineering manager with Messrs. R. Napier and Sons, of Glasgow—and having been here for about three years, I can endorse all you say as to what the continental engineering firms are now able to do, and quite agree also with remarks you make as to the benefit likely to result from a better knowledge of this matter being more fully diffused amongst our home manufacturers and their foremen. In connection with this I have thought it might be of interest to you to receive particulars of the trial made a few days ago with a compound engine recently constructed by us for a large flour mill in Copenhagen. These particulars and some other data of the engine I have put in a form suitable for publication in your journal, if you think it worth while to do so. One set of the diagrams taken during the trial I also enclose herewith.

Trial of a Compound Engine.

No. of diagram	When taken.	Steam pressure.	Receiver pressure in lbs.	Vacuum	Revolutions.	Indicated horse-power.		
						H.-pres. cylinder	L.-pres. cylinder	Total.
1	9.0 a.m.	61	5	25·1	66	160	180·6	340·6
2	9.30 ,,	61	4	25·8	66·5	158	167·3	325·3
3	10.0 ,,	61	4	25·8	66·5	154·4	172	326·4
4	10.30 ,,	60	5	25·8	66·5	158·4	181·2	339·6
5	11.0 ,,	60	5	25·8	66·5	156·7	179·2	335·9
6	11.30 ,,	61	4	25·7	66·5	157·7	171·5	329·2
7	12.0 ,,	62	3·75	25·85	66·5	155·1	172·8	327·9
8	12.15 p.m.	61	1·3	25·85	68	149·6	140·5	290·1
9	12.30 ,,	63	1	25 85	67·5	149·5	143	292·5
10	1.0 ,,	61	1·6	25·75	67·5	151·3	152·3	303·6
11	1.30 ,,	60·5	2·0	25·5	67	152·5	154·8	307·3
12	2.0 ,,	60·5	0	23·46	66·5	139·1	127·4	266·5
13	2.30 ,,	61	0·5	23·78	66·5	141·1	131·4	272·5
14	3.0 ,,	61	0·5	23·58	66·5	139·9	134·4	274·3

In the preceding table are given particulars of the trial of a compound engine recently made by Messrs. Burmeister and Wain, of Copenhagen, for a large flour mill in that town. The engines are ordinary horizontal compound condensing engines, having two

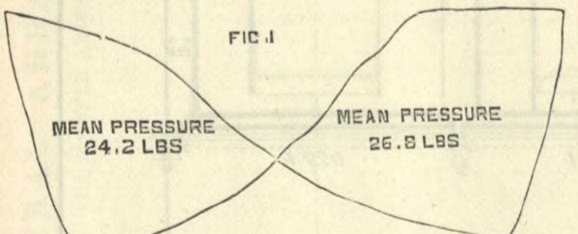
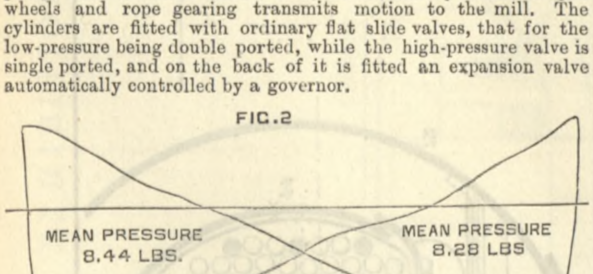


FIG. 1

cylinders 25in. and 44in. diameter by 3ft. stroke, working directly upon two cranks placed at right angles to each other, the one end of the crank shaft being provided with a crank for working the air pump, while the other takes the fly-wheel, and by means of spur wheels and rope gearing transmits motion to the mill. The cylinders are fitted with ordinary flat slide valves, that for the low-pressure being double ported, while the high-pressure valve is single ported, and on the back of it is fitted an expansion valve automatically controlled by a governor.

FIG. 2



Referring to the table, it will be seen that the trial lasted for six hours, during which time indicator diagrams and other particulars were taken every half hour, under the control of a representative of the builders, and an engineer acting on behalf of the owners. These two gentlemen also controlled the measuring of the feed-water and the weighing of the coals, which were of fairly good Welsh quality. It will be seen from the table that during the first three hours the horse-power averaged 332, but as this was more than the contract stipulated for with 67 revolutions, it was arranged for the remaining three hours to reduce the amount of work, this being effected by throwing off a portion of the mill machinery, without touching the engine, the governor automatically controlling the expansion valve. During the first three hours there was burned 1710 lb., and during the remaining three hours 1441 lb., which gives for the mean horse-power of 309 a consumption at the rate of 1·7 lb. per hour per indicated horse-power. The amount of water evaporated during the six hours was 26,660 lb., being at the rate of 8·46 lb. of water per pound of coal. The feed-water was taken from a tank supplied from the corporation pipes, and its temperature in the tank was 60 deg. Fah. The discharge water from the feed pump passed through a feed heater attached to the engine, and its temperature, after leaving the feed heater, was 121 deg. Fah. The injection water for the condenser was taken from the harbour, its temperature being 61·5 deg. Fah., while the waste water from the air pump was 86 deg. Fah. A set of diagrams is given, from which it will be seen that the distribution of the steam is very good.

David Halley.

Copenhagen, September 30th.

HALL AND VERITY'S FLEXIBLE CRANK SHAFT.

Sir,—I have seen Messrs. Hall and Verity's crank shaft illustrated in your last number. I shall be much obliged to them if they will kindly explain in what their invention consists. It seems to me that their flexible crank shaft is, in most respects, identical with that used in paddle steamers, the paddle shaft crank-web being always distinct from the engine or intermediate shaft, the end of the crank pin fitting loosely in the paddle shaft web.

Shields, October 6th. Rotifer.

Sir,—In glancing over the sketches and description in your last week's issue of Messrs. Hall and Verity's patent crank shaft, it recalled to my mind an incident that occurred some seventeen or eighteen years ago. I was at that time working as a millwright at Messrs. Annandale's, Shotley Bridge, and in their mill there was a pair of compound horizontal engines working up to about 120-horse power. They were practically new, built by Messrs. Stephenson, of Newcastle-on-Tyne, and owing to the main shaft and crank pins not running true, one of the latter broke. To overcome the difficulty and prevent the main bearings heating, a crank pin was put in fixed in one of the webs, but free to move in the other web, which had a fixed brass bush; if I remember correctly the inner surface was slightly convex to allow the pin to adapt itself to inequalities in the level, the pin, of course, being free to move laterally. The convex bush used by Messrs. Hall and Verity is no doubt an improvement; at the same time it is only another of the numerous instances of similar ideas striking different people. I think it was Mr. George Crow, who was for many years connected with Messrs. Stephenson's, who suggested the loose pin on the occasion to which I refer. R. E. Proudlock.

Oldbury, October 6th.

THE CONTINUOUS BRAKE RETURNS.

Sir,—I have read with surprise the letter by Mr. Henry Prince in your last issue, more especially because it contains such convincing proofs that this correspondent has undertaken to write upon the important subject of continuous brakes without being acquainted with even the preliminary requirements.

On the 22nd of April, 1880, the Board of Trade issued a circular in which the returns relating to failures were considered very unsatisfactory, and desiring that the information should be of a uniform character, and arranged so as to be easily compared, that it should be limited to, and include all instances in which the safety of the trains is concerned, and directed that the replies should, in future returns, be given under the three following heads:—

"(1) Failure or partial failure of the continuous brakes to act when required in case of an accident to a train, or a collision between trains being imminent.

"(2) Failure or partial failure of the continuous brakes to act under ordinary circumstances to stop a train when required.

"(3) Delay in the working of trains in consequence of defects in, or improper action of, the brakes, distinguishing whether they arose from neglect or inexperience of servants, or failure of machinery or material."

Mr. Prince evidently knows nothing either of this Board of Trade circular of April, 1880, or of the three heads under which the failures are to be recorded, for he asks if Mr. Stretton is perfectly unprejudiced in his views in bringing forward this second clause. It is hardly necessary for me to say that my opinions on the brake question are perfectly unprejudiced, and certainly I took no part in drawing up the Board of Trade circular of 1880.

Leicester, October 6th. Clement E. Stretton.

SIGNAL SEMAPHORES AND THE EARLS COURT ACCIDENT.

Sir,—In your paper of August 28th, under the heading "Railway Matters," you notice the fatal collision at Earls Court Junction, and at the latter part of it you say, "It is difficult to see how this could be if semaphores were weighted to fly to 'danger' in case of such breakage." It formerly was the practice not to balance the signal arms themselves, so that in the event of the rod breaking the arm itself would assume the danger position, and in many cases this is not done now; but it has been my practice for the last eight years to manufacture signals on the principle that if any part of the connections between the lever in the cabin, and the signal arm itself on the post should give way, the semaphore arm would go to danger.

I enclose a tracing showing our standard pattern of signal, and you will notice that there are very few parts in it, and the casting which carries the red glass and forms the semaphore journal and arm carrier is of such a weight as to counterbalance the wood arms so that whatever portion of the signal connections may give way, the arm is sure to go to "danger," and is therefore all that is required. G. Edwards.

The Railway Signal Company, Fazakerley, Liverpool.

BOILER EFFICIENCY.

Sir,—I have been much interested in the correspondence on the above subject which has appeared in your valuable journal. I do not quite see the connection between the subject matter of the letters and the efficiency of boilers. The boiler may be the best of its kind, but still incapable of utilising all the heat produced from the fuel burnt in the furnace. The question seems to me to be, how to economise the cost of producing steam power.

Every engineer, particularly those employed on board ship, knows that an immense deal of heat in the shape of flame, soot, and smoke passes away through the funnels, and is wasted in the atmosphere; and it appears to me that the object of the invention referred to is to prevent this waste of heat. This the inventor proposes to do by working the furnace with the damper nearly closed; but as this would stop the draught, he supplies the necessary amount of oxygen to the furnace by means of a fan—and I cannot see why the arrangement should not be successful. If this inventor—whoever he is—succeeds in saving 50, or even 20, per cent. in the cost of steam power, he will deserve something better than empty thanks.

The condensing engine is now as perfect as human ingenuity can make it. Anything further in the way of economy must be sought in the direction indicated by the inventor of the apparatus above referred to. Old systems die hard, and I shall be greatly surprised if tall chimneys are not, ere long, regarded as things of a bygone age. When forced draught is used the waste of heat is much greater, as not only flame, soot, and smoke, but live cinders, are sometimes strewed over the decks, to the danger of the ship herself. Your inserting this will greatly oblige. T. Williams.

Avonmouth Dock, October 7th.

The Manchester Ship Canal Company.—The preliminary prospectus of this company was issued on Tuesday. It is proposed to raise the £8,000,000 of capital by the issue of 800,000 shares of £10 each—10s. per share being payable on application and 10s. on allotment, and the remainder at such periods as may be found necessary.

AN ACCOUNT OF THE EXPERIMENTS MADE ON A CONDENSING COMPOUND ENGINE BY A COMMITTEE OF THE INDUSTRIAL SOCIETY OF MULHOUSE, IN ALSACE, GERMANY.

By Chief Engineer Isherwood, U.S.N.

(*Concluded from page* 267.)

The water data of the experiments afford a striking illustration of the transmutation of heat into power. The temperatures of the feed water, and of the condensing water when admitted into the condenser, being known, and the respective weights, the number of units of heat imported to the feed water in the boiler, and the number present in the condensing water and water of condensation when withdrawn from the condenser, are easily calculated, and the difference is the number of units of heat transmuted into the work done in the two cylinders of the engine by the expanding steam; that is, into the work done in those cylinders after the closing of the cut-off valve of the small cylinder. An explanation is necessary of the manner in which the horse-power developed by the engine are calculated. Under the head of "horse-power" five kinds will be found in the table, namely, indicated, net, developed by the expended steam alone, total, and delivered by the engine to the factory shafting at the friction brake. The first three and the last are different fractions of the fourth. The indicated horse-power is computed from the mean indicated pressure given by the indicator diagrams taken from the cylinders, and is given separately for the small and large cylinder, the aggregate being the indicated horse-power developed by the engine. The main shaft of the engine being disconnected from the factory shafting, and the engine worked *per se*, or unloaded, indicator diagrams were taken at different speeds of piston, and showed that the pressure per square inch of the piston of the small cylinder was 3·627455 lb., and that the pressure per square inch of the piston of the large cylinder was 1·258947 lb., and that these pressures were constant for all speeds of piston. They are then the pressures which equilibrate the friction of the moving parts of the engine, and they must be supplied before the pistons can move, so that only what remain of the indicated pressures on the pistons of the two cylinders after the subtraction of respectively these friction pressures are applied to the crank-pin and do work external to the engine. These remainders are termed the net pressures, and the horse-power calculated from them is termed the net horse-power. The net horse-power developed by the engine differs from the horse-power developed by the engine at the brake, by the friction of the load on the moving parts of the engine. When the load, or the factory shafting, is connected to the engine shaft, then a friction is thrown upon the journals and other moving parts of the engine, additional to the friction of the engine, *per se*, and proportional to the load, being a constant per centum of it. Consequently the horse-power developed by the engine at the brake must be less to the extent of the horse-power required to overcome the friction of the load, than the net horse-power developed by the engine as above computed. The total horse-power developed by the engine represents the entire work of all kinds performed by the steam, including, of course, the overcoming of the back pressure against the pistons of the two cylinders. This power is composed of the sum of the indicated horse-power developed in the two cylinders and the horse-power required to overcome the back pressure in them against their pistons. Now the pressures for the latter horse-power are composed of the back pressures against the pistons, exclusive of the back pressures of the cushioned steam in the two cylinders. That is to say, the mean of the back pressures from the end of the indicator diagrams opposite the cushioning end up to the point in the stroke of the piston at which the cushioning commenced is taken for the back pressure, and the length of the stroke of the piston through which the back pressure operates is the length between the same points. Consequently the horse-power required to overcome the back pressure is calculated for a different stroke of piston than the stroke used for the calculation of the indicated and net horse-power, and different for each cylinder because the cushioning takes place at a different point of the stroke of the piston in each. The horse-power required to cushion the steam, though expended in overcoming back pressure, is not included as such, because the cushioned steam thus obtained remains in the cylinder—not being exhausted to the condenser — and diminishes by that much the steam drawn from the boiler per stroke of piston. The economic value of this compressed steam is equal to the compressing power expended upon it, therefore this power is restored during the succeeding stroke of piston by the cushioned steam. If the power expended in cushioning the steam was added to the power expended in overcoming the other back pressure, then the weight of steam so cushioned per stroke of piston would have to be added to the weight drawn from the boiler per stroke of piston, in order to obtain a proper measure of the cost of the total horse-power. The cost of the indicated and net horse-power is, however, the number of units of heat in the weight of steam drawn from the boiler in a given time, whether there be cushioning or not, or to what extent.

For the small cylinder the calculation of the indicator, net, and total horse-power developed in it, is made for the entire area of its piston, the back pressure being computed down to the zero line. But for the large cylinders the calculations are so made for only the indicated and net horse-power. For the total power, the back pressure down to the zero line is computed as against only the ring or annular area which remains of the piston of the large cylinder after the piston of the small cylinder has been subtracted from it. The reason of this is that the back pressure, due to the piston of the small cylinder, has already been computed down to the zero line. In the small cylinder, the total horse-power developed by the expanded steam alone is computed for the mean pressure down to the zero line of the indicator diagram from the point in the stroke of the piston at which the cut-off closed to the end of the stroke, for the entire area of the piston, and for the length of stroke from the point in the stroke of the piston at which the cut-off closed to the end of the stroke. For the large cylinder, the total horse-power developed by the expanded steam is the sum of the indicated horse-power developed in that cylinder, and of the horse-power expended in overcoming the back pressure, including that of the cushioning against the ring, or annular area, which remains of the piston of the large cylinder after subtraction of the piston of the small cylinder, and for the entire stroke of the piston, because all the steam which enters the large cylinder is used expansively from the beginning to the end of the stroke of its piston; and as the question is not horse-power *pro rata* to steam furnished from the boiler, but horse-power absolutely exerted by expanding steam, and for which there is *pro rata* liquefaction of steam in the cylinder, the power expended upon the cushioning must be included. The cost of the indicated, of the net, of the total horse-power, and of the horse-power developed by the engine at the brake, is given in the table, both in pounds of feed water consumed per hour, and in Fahrenheit units of heat consumed per hour. The first is the measure popularly adopted, because easily expressed, and is sufficiently accurate for practical purposes, but the latter is absolutely correct under all circumstances. The difference in the two measures, for the conditions of ordinary practice, is not great, because the total heat of steam of different pressures within those limits does not vary largely, but the latter measure should be preferred when strict accuracy is needed, as in the case of comparisons. For the present experiments, however, in which the initial pressure upon the piston of the small cylinder, and the back pressure against the piston of the large cylinder, and the temperature of the feed water, varied to only a trifling degree, the difference in the two measures is nearly nothing.

In calculating the quantity of heat transmuted into the horse-power developed by the expanding steam—after the closing of the cut-off valve in the small cylinder—one Fahrenheit unit of work, taken as the thermal equivalent of 789¼ foot-pounds of heat is which gives 41·811847 Fahrenheit units as the thermal equivalent of 1-horse power—33,000 foot-pounds of work per minute. Con-

TO CORRESPONDENTS.

*** *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.*

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

*** *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.*

T. B. H.– *Fairbairn "On Millwork;" Box "On Gearing."*

J. F.—(1) *No one can tell steel from iron if both are so rusty that the surfaces cannot be seen.* (2) *Creosote.*

MILK CONDENSING MACHINERY.

(*To the Editor of The Engineer.*)

Sir,—Will any of the readers of The Engineer inform me of the name and address of the makers of milk condensing machinery? W. W.

TIMBER PRESERVATION BY SULPHATE OF COPPER.

(*To the Editor of The Engineer.*)

Sir,—We have been applied to by a foreign correspondent for information as to the best method of preserving sawn timber by means of sulphate of copper. We shall be much obliged for any information with which any correspondent may be good enough to favour us respecting this process.

Hyde, September 29th. A. P. and Co.

DEATH.

On the 5th inst., at Etruria, Stoke-upon-Trent, S. R. Linging, Assoc. M. Inst. C.E., aged 34.

THE ENGINEER.

OCTOBER 9, 1885.

ZINC IN MARINE BOILERS.

It is an almost universal custom to put zinc plates, balls, or slabs into marine boilders. The object had in view is to prevent corrosion, the zinc wasting while the boiler remains sound, because zinc is more readily oxidised than iron or steel. But zinc exercises another influence, which may be either bad or good, according to circumstances. If the zinc is properly used, and in sufficient quantity, it will prevent deposit from adhering firmly to the heating surface of the boiler. If it is used improperly, there seems to be no doubt that it has the opposite effect, and renders deposit harder and more tenacious than ever in its grip on the plates. This is a very important proposition, and deserves careful consideration from all users of steam boilers. It was brought prominently before the North-East Coast Institution of Engineers and Shipbuilders, by Mr. John A. Rowe, in a very well written and able paper, read in Sunderland on the 18th of March. Before going on to consider Mr. Rowe's statements, it may be worth while to give the Admiralty rule for the use of zinc in the Navy:—"Zinc slabs are to be suspended in convenient parts of all boilers, and the engineer officer in charge of the machinery at each inspection of the boilers is to examine these slabs, and their condition is to be noted in the engine-room register. The object of these slabs is a form a galvanic battery with the shell of the boiler, and by making the surface of the latter below water the negative pole, throw it into a condition in which it cannot be corroded. To effect this object special care must be taken (*a*) to ensure perfect metallic contact between the zinc slabs and iron stays, or part of the plating of the boiler to which the zinc is attached, the surfaces in contact of iron with iron or iron with zinc being filed bright, and means adopted to secure a firm grip; (*b*) to place the slabs in such positions that every portion of the iron surface may be protected; (*c*) to replace by new slabs any found on examination to be deteriorated. If oxidation manifests itself in any part of the boiler, it will probably be caused by the nearest zinc slab being at too great a distance; in which case its position should be altered, or an additional slab introduced; or the oxidation may arise from the zinc being decayed, or in imperfect contact with the iron." As to the quantity of zinc necessary, the Admiralty Committee on Boilers, after a most valuable series of experiments extending over long periods of time, reported: "It is known that a comparatively small proportion of zinc surface—something like 1 in 150, if properly distributed—will protect the iron to which it is attached from corrosion; but the zinc gradually becomes decayed, and the efficiency of its protection gradually diminishes. It becomes necessary, therefore, to get such an excess of zinc surface at first as will ensure efficient protection until an opportunity occurs for renewing the zinc. It has also been observed that in new boilers, or in boilers where the zinc has not been renewed lately, the decay of the zinc when first fitted is much more rapid than when the same boilers have been in use for some time with the zinc regularly renewed. Sufficient zinc must therefore be fitted in such boilers to meet the unusually rapid decay, or arrangements must be made for its more frequent renewal." As a general rule, it may be taken that in the Navy seven square inches of zinc are used per indicated horse-power in new boilers, and five square inches in old boilers. "The result," says the committee, "of the use of zinc is the formation of a harder and more adherent lime scale."

Turning now to Mr. Rowe's paper, we find that he thus criticises the statement we have last quoted:—"Since this was written, now five years ago, it is probable such experience has been gained as to justify one in writing as follows:—When very weak currents of electricity are produced by the corrosion of zinc in a boiler, they tend to cause the scale which forms on the inner surfaces to adhere, just as weak currents of electricity promote electro-plating; but when stronger currents are established they prevent deposition, and loosen the hard adherent scale which for years has been inaccessible to the scaling tool." It seems beyond question that when considerable quantities of zinc are used deposit is found in a loose kind of way; but we cannot accept Mr. Rowe's explanation of the reason why as satisfactory. His idea is that hydrogen is liberated from the iron in quantity so great that it prevents the deposit from forming. Admitting this to be true of new boilers—which we dispute—it is not easy to see how iron plates already thickly coated with an impervious scale can be got at by the water at all, and if the water does not get to them, there can be no hydrogen set free. Mr. Rowe gave the results of experiments, which go to show that so long as the zinc is kept clean, and is, in fact, not polarised, so long will deposit be loose and corrosion *nil*; but the moment the zinc becomes coated thickly with its own oxide, it ceases to be of use. To keep the zinc fairly clean, it has been found sufficient to introduce a small quantity of soda into the boiler. The quantity used is 2 lb. per day of ordinary carbonate of soda per ton of coal burned. It is stated that boilers thus treated will run for forty-five days without opening or cleaning, the scum cocks being used now and again to remove froth. The density of the water rises to about $\frac{4}{32}$. Mr. Rowe had the soda and zinc system tested on Tyneside. For two months two boilers side by side were worked, one with soda and zinc, the other with a small quantity of salt added to the water, and zinc. The results were negative as regards the boilers, the deposit being soft in both, but the oxide formed on the zinc plate was friable and easily removed when soda was used, and hard in the boiler worked with salt water. It is to be regretted that the discussion which followed on Mr. Rowe's paper added very little of interest.

In a recent impression we wrote at some length concerning the management of high-pressure marine boilers, and this article may be regarded as, in a sense, a sequel to that which appeared in our impression for Sept. 25th. We there showed that there can be no worse practice adopted than the perpetual changing of the water in the boilers when surface condensers are used. Sea-going engineers have a tremendous prejudice against a high density. It is very difficult, however, to extract from them any intelligible explanation of the prejudice. When jet condensers were used it was absolutely necessary to keep down the density to prevent the boiler from salting up; but with the surface condenser the quantity of deposit is strictly limited, as we have previously shown; and if fresh supplies of sea water are kept out of the boiler no risk is run, no matter how dense the water becomes. There is some reason to think that the rise in density which does take place is due in some measure to all the air being boiled out of the water. Not only, however, may boilers which are quite tight be worked for long periods without changing the water, but they have been so worked. Thus, for example, the Government tug Sampson was worked from the 27th of November, 1878, to the 18th of March—that is to say, the same water remained in her boilers 110 days, and the fires were alight sixty-one days. They were found to be in admirable condition, with a very thin scale all over the heating surface. Experiments made with the tug Malta showed that a density of $\frac{4}{32}$ gave better results than a density of $\frac{2}{32}$. Of course the case becomes complicated when we have leaking condenser tnbes to deal with; the salt water will find its way into the boiler whether we like it or not. Again, when steam is drawn from the main boilers for winches or heating purposes, the conditions are changed. The drain pipes from cylinder jackets ought always to lead to the hot well, and safety valves ought to blow off into the condenser. In this way the quantity of auxiliary feed required would be much reduced.

To put the matter in its simplest form, it may be said that the best way to work a marine boiler is to put into it, as we have explained, a sufficient quantity of good zinc; to fill up with salt water at starting, and to add no more water during the voyage, the brine and scum cocks being kept shut. If these conditions can be observed, the boiler need not be opened and cleaned oftener than once in three months, provided the zinc plates last so long in good condition. The density of the water will be found to rise by degrees—which is the more remarkable, because it soon gets rid of all the lime and magnesia—and may get as high as $\frac{4}{32}$ or even more, without the smallest risk. This may be regarded as method of working No. 1, and is the best that can be adopted. According to method No. 2, the supply from the hot well will not keep the water up in the gauges, either because safety-valves blow-off, glands leak, steam is used for heating the ship, or working winches, or the jackets blow into the bilges instead of the hot well. Seeing that as much as ten or twelve per cent. of all the water evaporated may be condensed in the jackets if they are kept properly blown down, it will be understood that the loss of feed may be very considerable. Under these circumstances the donkey must be used, or the auxiliary jet feed. Care must then be taken that the density does not exceed $\frac{3}{32}$, or a deposit of salt may be going on, which will be capable of mischief. It is certain, under these conditions, that lime will be thrown down either as a hard scale or as mud; the chances being ten to one in favour of the former, unless, indeed, the quantity of zinc used is very large, and some soda is added to the water, in which event the deposit will be probably mud. Under these working conditions the boilers ought to be emptied, opened, and cleaned every ten days. Whether they can be run with safety or not for a longer period depends altogether on the quantity of auxiliary feed put in. It may be taken that the sea-water with which the boiler is first filled up contains lime enough to give the surfaces a coat of deposit about as thick as a well-worn sixpence, or rather less. The thickness of this coat will be doubled every time as much sea-water is added as was originally in the boiler. Thus, let the boiler start with 15 tons of water in it; this will produce a scale, say, one-fiftieth of an inch thick. Then every 15 tons of sea-water pumped in will double this scale. Fifteen tons is only 3360 gallons, and a big donkey pump will not take long to pump this quantity into a boiler. Thirty-five cubic feet of sea-water weigh a ton. Let the stroke of the plunger of a donkey pump be 12in., and the diameter of the ram 4in.; then twelve strokes will discharge one cubic foot, or 420 strokes a ton. Allowing for "slip," let us say that 500 strokes go to the ton; then at 50 revolutions per minute a ton of water will be pumped in ten minutes. Sea-going engineers, as a rule, do not realise how much water a donkey will throw. They think nothing of blowing down a boiler three inches or so every watch, and then pumping it up again. Under such conditions it is impossible but that either scale or mud must accumulate, and it is therefore essential that the boilers should be frequently opened and cleaned out. One-half the trouble caused by the coming down of furnace crowns is due to the lavish use of the donkey. The other half is probably due to the captain, who does not give the engineers time to get boilers opened and cleaned.

DOCKS FOR THE EAST.

We recently wrote relative to a presumed difficulty as to the locality to be selected for the construction of a dock in Ceylon. It had been assumed by the local press of that colony that Sir John Coode had been instructed to prepare a report upon the capacity of Trincomalee for such a purpose, to the total exclusion of what the colonists deemed to be the superior claims of their maritime capital, Colombo, which is admitted to be one of the foremost, if not the very foremost, of our coaling ports in the Eastern seas. At the time we penned our former remarks on this subject, we had accepted the comments of the Ceylon press relative to it as conclusive. We have, however, since learned that they were based upon a misapprehension of the real facts, and that the question has a far wider bearing than the controversy as to whether Colombo or Trincomalee should have preference in selection.

We do not see that it can be disputed that our naval interests in the East demand that every possible accommodation should be provided for the ready and constant docking of the ships composing the naval squadron employed in Indian waters. Indeed, we had always presumed that at Bombay, at least, there existed such accommodation; and it is with considerable surprise that we learn that at the present date it is impossible to dock our large ships of modern construction at that port. For some time past the hydraulic lift at Bombay has, from some cause or other with which we are unacquainted, failed to answer this purpose. It is not unnatural to surmise that this failure may have been due to overstrain in the endeavour to raise vessels of a size beyond its safe capacity. However that may be, we understand that this lift has been condemned by the Government officials, and that it has been, or soon will be, sold to private parties. With this failure has come about a total want of docking accommodation for the larger ships of the East India squadron. Year by year the exigencies of service and the change in the practices of naval warfare, as well as the demands of our Eastern commerce, have rendered it necessary to considerably enlarge the size and power of the vessels which compose that squadron. For the smaller ships there exists ample accommodation at Bombay, but for those of a higher class it is now absolutely *nil*. We can readily appreciate, therefore, the desire of the Admiralty to provide for this urgent want without delay, and as readily realise the force of the reasons which lead its officials to entrust to Sir John Coode the commission which has been one of the principal objects with which he has undertaken his present journey.

It was from a misconception of, or want of full information as to, the instructions given to Sir John Coode, that the impressions of the Ceylon press to which we have adverted arose. We now understand that the Admiralty instructions to that gentleman were to report upon the relative advantages for the purpose desired afforded by the three ports of Bombay, Colombo, and Trincomalee. We also learn that between these ports there is no preference felt, and that the assumed predilection in favour of Trincomalee rests upon no sound basis. The Admiralty feels that its want is pressing, and for the reasons we have above given there can be no doubt but that it is so. The Board would, of course, gladly welcome the establishment of docks suited to its needs at each and all of the above-named three ports, but it is beyond present likelihood that this can be provided. The alternative is, therefore, forced upon it of securing the best accommodation procurable at the earliest possible date. It is, indeed, to a very great extent a question of time. The recent dread of war with a great European Power must necessarily have forced the question strongly into consideration. Such a calamity occurring must have ensured the dispatch to Eastern waters of a large and powerful fleet; and it would have crippled its efficiency most seriously if the ships composing it were debarred from the means of ready docking for the constant cleansing which a ship sailing in tropical waters requires. The fouling, which is common and rapid enough even in temperate seas, is greatly accelerated in those of the tropical zone, and there is a consequent absolute necessity for more frequent docking and cleansing. The desire of the Admiralty must, therefore, be shared in by everyone of us, and we can sympathise with its wish to provide for the contingency with the least possible delay.

Now, it unfortunately happens that, as we pointed out in our article dealing with this matter as it affected Ceylon interests only, there can be no doubt but that Colombo is heavily handicapped as regards the advantages in point of time which are certain to prove so important a factor towards forming the conclusions of those charged with the supervision of our naval affairs. As we then stated, Colombo possesses at present no site which can be readily adopted as that of a dock of the dimensions required. This fact would seem to leave no room for possible competition between it and Bombay or Trincomalee. Were the selection narrowed to these two last-named places, we hold that preference must certainly be given to the second. It is, perhaps, almost without exception the finest naval port in the world. Capable of holding, and affording secure anchorage to an immense number of ships of the largest size and the heaviest draught of water, its whole area is surrounded by hills, offering sites for batteries capable of giving the greatest amount of defence to the shipping by a cross fire covering its entire surface, as well as rendering its narrow entrance impassable by the ships of an enemy. It affords, further, in a most pre-eminent degree, facilities for defence by a system of fixed torpedoes; while apart from these military considerations, it has a position not far from the immediate track of the much greater proportion of our Eastern commerce. Even if we assume that, as regards Bombay, military advantages can be reckoned *pari passu*—an assumption, however, which, we believe, can hardly be correctly made—we still must see that that port presents no corresponding advantage in the commercial sense we have referred to. With the exception, indeed, of the Persian Gulf trade, Bombay may be said to constitute a *cul-de-sac* as regards shipping *en route*. It is mainly a port of final arrival. Apart from that fact, Bombay is already possessed of ample dock accommodation for vessels of the mercantile marine, and its claims for further dock construction cannot therefore be supported by any purely commercial consideration such as we have said must weigh so heavily in favour of the selection of a Ceylon port. It seems to us, therefore, to be evident that any choice must necessarily lie between Colombo and Trincomalee; and that narrowing the subject brings us once again to the question of the disability to which we have above stated Colombo is at present subjected.

In our previous article we made mention of the refusal of the Governor of Ceylon to comply with the requisition of the inhabitants of that colony to undertake at once the construction of the northern breakwater, which Sir John Coode states to be required to insure perfectly still water in their newly-formed harbour. We then stated our opinion that the objections advanced by him appeared to us to rest upon most untenable grounds; but it is not our intention to further revert to them here. But the whole aspect of the question, as it was at that time presented to the governor, has since been changed. It is only by the construction of this northern breakwater that an eligible site for the dock, called for by our naval necessities, can be obtained at Colombo. If, therefore, the Colonial-office, in its desire to uphold Sir Arthur Gordon's decision, refuses to view the matter under this changed aspect, Colombo must lose the inestimable advantage of securing that the projected dock shall be added to its present accommodation. As we have said, the Admiralty cannot afford to wait. We have pointed out the causes which make its wants urgent, and no blame can rest upon its officials, if, finding the indisposition to make Colombo available still remains operative, it decides, when Sir John Coode's report is received on his shortly expected return to England, in commencing at once upon operations at Trincomalee.

We have before advocated, and have in this article further advocated, the superior claim in a commercial sense which Colombo possesses, but we cannot expect other and higher considerations to be set aside in its favour. It seems to us, from the information received since last writing on this subject, that the determination of the matter rests entirely with the colonists of Ceylon, or rather, with those authorities who somewhat arbitrarily control the expenditure of the revenue. We cannot doubt but that the decision practically rests with the present governor of the colony, Sir Arthur Gordon. A very grave responsibility must remain with him should he fail to see how great an error he will commit, and how largely he must sacrifice the interests entrusted to him, should he longer hesitate with respect to them.

MR. HAWKSLEY AND HIS REMUNERATION.

A singular grievance on the part of Mr. Hawksley, C.E., has arisen out of the dispute respecting the Vyrnwy Waterworks, to which we referred some time ago. The discovery that these works would cost much more than had been contemplated showed that changes in the designs had been made by Mr. Hawksley, the engineer-in-chief, or by Mr. Deacon, the resident engineer and Liverpool water engineer, or by both, without the joint action and accord intended: hence the excess over estimates. The controversy thus created resulted in the resignation of Mr. Hawksley, but the matter did not end there. It appears to have degenerated into an unworthy wrangle, in the course of which the statement was made that Mr. Hawksley, as engineer-in-chief of the Vyrnwy works, had been receiving £10,000 a year "for doing nothing." To this serious indictment Mr. Hawksley gives a direct denial. "I, with a large staff," he says, "have worked most assiduously and energetically for the Corporation for six years, during which time I have been paid exactly £9000, and have expended in cash much more than that amount. I am, in fact, largely out of pocket at the present time; but I have claims under my agreement which, when liquidated, will cover my outlay, and leave me an unsatisfactory remuneration besides. Of course I can expect no more than I am strictly entitled to, however bare may be the result. By remaining in office I might in some measure mend my pecuniary status, but this—after the treatment I have received—I cannot descend to." Having thus disposed of that misstatement, Mr. Hawksley corrects another. It seems to have been said that his resignation was due to a personal squabble between himself and Mr. Deacon. That, however, he states, is not the case, but is the result of the very disagreeable discovery made by Mr. Forwood"—a prominent member of the Liverpool Corporation—"that there had been (1) a concealed agreement; (2) a claim to a joint engineership—not disavowed even by the Water Committee till a few days ago, and then too late, for I had, in pursuance of my notice of the 18th of July, previously vacated my office; and (3) an expressed intention to hold me responsible for the unsanctioned acts of an—unreal—assistant, who has persistently asserted a position of equality, and has therefore established a 'dual control' at, as is pretended, my individual risk." Mr. Hawksley's resignation is expected to receive future consideration by the Town Council, so that the matter is not even now closed; but it may be hoped that it will soon be concluded amicably, despite the strong things that have been said.

THE THREATENED GENERAL STOPPAGE OF COLLIERIES.

The greater portion of the large colliery districts of the United Kingdom is again threatened with a cessation of labour, and afterwards with a limitation of the output, if such a scheme can be ever got to work, which is more than doubtful. Those who are interested in mining pursuits need not be told that several similar attempts have been fruitlessly made. The minutes of the three days' conference, which was held last month with closed doors at Nottingham, state that the Credential Committee reported that 111,300 men were represented by nineteen districts. Of these 34,000 are returned as belonging to the Yorkshire Miners' Association, 15,000 to the North Staffordshire Miners' Federation, 8000 to Ashton and Haydock, 9000 to Derbyshire, 6900 to the Lancashire Miners' Federation, 6000 to West Bromwich, 3700 to Nottingham, and 3000 to the Wigan Miners' Association. It would therefore seem that the decision that all districts demand an advance of 15 per cent., or a cessation of labour, was come to by Lancashire and Yorkshire delegates who represented over 64,000 men and boys. Both districts appear to be favourable to the carrying out of the resolutions. The council of the Yorkshire Miners' Association has met during the week and decided that the coalowners shall be appealed to for an advance of 15 per cent., and for the establishment of a scheme for regulating wages in future. The replies of the owners are to be laid before a conference of the Yorkshire delegates to be held on Wednesday, October 14th, at Barnsley, whilst on the following day the whole of the districts meet at a conference to be held at Manchester, when in addition to receiving reports, the best means of limiting the output of coal will also be considered. It is worthy of note that neither Durham, Northumberland, nor the Scotch miners are taking any part in the movement. So far as Yorkshire is concerned the miners have scarcely recovered from an eight weeks' strike, waged to resist a reduction of 10 per cent., which, notwithstanding all efforts put forth, took effect. Should the men agree to come out there can be no doubt but that another fierce battle will be the result, as the owners are banded together in an Assurance Association for Mutual Protection, which of late has become considerably stronger, each owner paying a tonnage rate of 6d. on the quantity raised, and compensation in return if their pits are shut up.

OUR MERCANTILE NAVY.

The reports of the Registrar-General of shipping and seamen are acquiring interest because it is becoming clear that the lessened building of vessels and their frequent loss are at last affecting the total of our carrying power. Taking the last return we find that there were added to the registries 114 vessels, the net register tonnage of which was 38,974 tons, and the horse-power 2708. In the same period there were removed from the registries 166 vessels, the net register tonnage of which was 37,915 tons, and the horse-power 3158. It thus appears that at the first blush the tonnage removed in one of the summer months is nearly equal to that of the tonnage added, whilst the horse-power of the vessels removed is greater than that of the vessels added. This divergence is explained easily by the remembrance of the heavy building of sailing vessels of late. The carrying power is now much more indicated by the horse-power than by the ton, and thus it is clear that at the present time we are reducing the capacity of our mercantile navy. If the details from which the above figures are summarised are examined, it will be found that the tendency is more marked, for the ships added include numbers of small vessels for river service or other special use, whilst those removed from the register are chiefly vessels of the usual seagoing type. We may add that of the ships removed from the registers, forty-one were broken up, a very large number out of 166, but a number which will probably cause a reduction of the losses in the future. Of those broken up, one dated back to 1817, and several to the years between 1830 and 1840; so that it would appear that the mercantile navy is being not only thinned by sea loss, but also by some of the older vessels being weeded out. It is one of the not unusual accompaniments of a period of low values in vessels and of cheap construction, and it is a fact which will have its influence not only on the freight market by lessening the competition therein, but also on future construction, by thinning the working fleet and causing the need for increased building in the future.

WAGES AND COMPETITION IN THE IRON TRADE.

The wages question is again coming to the front in the South Staffordshire iron trade. The matter is the more important since any step towards an alteration in the rate of payment which is taken in Staffordshire directly affects all the other iron trade districts, excepting the North of England and South Wales. Certain of the Staffordshire ironmasters are complaining that, as they put it, "just for the benefit of two or three of the leading bar firms," they are paying wages based upon a wholly fictitious price of iron. For nearly three years the quotation for marked bars has stood at £7 10s., and this quotation it is which regulates wages in the mills and forges. For a long time past, however, the quotation has been hardly more than nominal, except in the case of two or three firms indicated, and members of the trade are now beginning to assert that the time has arrived when wages should be paid upon a more actual basis. The question is forced upon the masters' attention with the greatest earnestness by reason of the increasing competition from the North of England. This competition began in angles, and some other engineering sections of iron, it then extended to plates and some sorts of sheets, and now it is manifesting itself in small merchant sections, such as strip for the manufacture of wrought iron tubes, and the like. These irons are being supplied to Staffordshire consumers in considerable lots at prices much less than those which native makers can afford to accept. In the forges and mills of the North of England wages are being paid which are sensibly lower than those in Staffordshire, and if the impending arbitration in the North should result in another fall in wages, the position of Staffordshire will be still further unenviable. The Wages Board there has already held an informal sitting, and it is clear that some alteration will have to take place before long.

THE NORTH BRITISH RAILWAY.

There are few railways possessing more interest just now than the North British Railway, because of its share in the building of the bridges needed to give completion to its line. In the past half-year the North British Railway expended on new works, apart from the capital expended on the Edinburgh and Southside Railway, the sum of £215,400, a considerable sum for the line. Out of that sum there was spent on the new Tay Viaduct during the six months £95,817, none of which was on the land or compensation, but all on the needed works themselves. It is intended to continue the expenditure at the same rate for the half-year which is now entered on, the estimated expenditure being £100,000 for the current half-year, and £174,572 for the future period during which construction may be needed. Except the doubling of the line north of the Forth Bridge, and the construction of the Glenfarg line, this is the only work of first-class magnitude the North British Railway has in progress, and those who know the estimated cost of the Tay Bridge will see from the figures of the estimated expenditure above given that a large part of the work is being done with some rapidity. The entire further expenditure of capital of the North British Railway from the end of its last half-year is put at £1,184,474, and the Tay Bridge, as we have seen, would take up about a-fourth of that amount, whilst the Forth Bridge line takes nearly £435,000. Apart from these great works the North British has nothing of much moment in hand, and thus the progress of the works it has been committed to, and which it has now in progress, will be watched with the greatest interest. They would not only very greatly facilitate the traffic between England and Scotland, but they would make complete practically one of our great railways in the North, one which is approaching its forty-second year.

PUTNEY BRIDGE.

This fine work now nearly approaches completion. It may be said, indeed, that little remains to be done to it save the superstructure above its arches. When their centreings are finally removed this bridge will undoubtedly vie in beauty with any of its numerous forerunners on the Thames. It can hardly be said that we view without regret the demolitions which the construction of its approaches have rendered inevitable on the Putney bank of the river. Perhaps there does not now anywhere remain to us a more quaint or old-world "bit" than has been sacrificed to utilitarian ends. Photographs will doubtless preserve to us the memory of those old gabled houses which offered so picturesque an entrance to the Putney High-street. They must have dated, we should say, from the fifteenth century, and it is regrettable that they could not have been preserved. Their demolition was, however, quite unavoidable. Perhaps no Thames bridge had a more dangerous approach than had the old structure, which is soon to be also removed, and no antiquarian consideration could have been permitted to stand in the way of the avoidance of a similar danger in the case of the new bridge. Very considerable ingenuity has been shown in overcoming the difficulties which presented themselves in the formation of the new southern approach. The sudden branching off of the river-side road just at the southern abutment made it most embarrassing to deal with, and we congratulate the designer upon the skill shown in overcoming the obstacles in his way.

THE PLUMBING TRADE.

We are glad to observe that the Plumbers' Company is preparing to take active steps to meet the many complaints lately made as regards the inefficient manner in which much of the plumbing work is done in new London houses. In no better way—should the action of the company prove successful in remedying the evil—could the usefulness of the much-abused City Guilds be demonstrated. It is no use our making stringent sanitary laws affecting house construction, so long as the criminal negligence of workmen renders them absolutely inoperative to secure the safety to health and life contemplated by them. We use the word "criminal" advisedly, for it is little less so on the part of a workman to so negligently perform his duties, or altogether neglect them, as to render possible the sacrifice of life or health. We daily have complaints of the perfunctory manner in which many men of the present day perform their work; but in no case does it present a more serious aspect than with men to whom are entrusted measures affecting so largely the public well-being as are those connected with the plumbing trade. We should protest against a slur being cast upon the whole body of a most respectable and highly valuable trade owing to the disgraceful shortcomings of a few unworthy members of it. These, we may hope, the action of the Plumbers' Company will soon cause to be driven from it. It is too bad that such men, knowing the ease and rapidity with which their shortcomings are concealed, should expose our whole population to an insidious and fearful danger.

THE PUMPING ENGINE IN STAFFORDSHIRE.

Suggestive information concerning the important work which is now being performed by the pumping engine in South Staffordshire in connection with the draining of the collieries was afforded on Wednesday at the annual meeting of the Commissioners having charge of the operations. By the construction of numerous levels along which the underground water is allowed to flow from various localities where it has hitherto been impounded to those shafts in central situations where the powerful engines of the Commissioners are at work, great economy is being effected in the engine power required. In the middle of last year the Commissioners were working fourteen engines. These have now been reduced to eight, and during the present year three more engines will be stopped. The cost for working the pumps for the past fiscal year is set down at £15,500. This was nearly £4000 less than in the previous year. The working cost this year is estimated at £9000, and that for the year after at £7000. Thus it will be seen how considerable is the saving which is being effected. But £7800 has had to be spent during the year upon the construction of levels, to say nothing of considerable sums previously spent in the same work. The expenditure is, however, wise, since collieries are now being rendered available for work which have for years been under water. The surface works of the Commission are also rendering valuable service.

LITERATURE.

History and Description of the Manchester Waterworks. By John Frederic La Trobe Bateman, F.R.S., Past President Inst. C.E., F.G.S., &c. London: E. and F. N. Spon. Manchester: S. J. Day. 1884. 4to.

The good books on water supply are so few that one from so high an authority as the author of that before us is a very valuable acquisition; for although it relates to the supply of but one town, that town is very large, and the works so extensive and varied, that this really is a book on waterworks generally. We believe Mr. Bateman is the first constructor in very extensive practice at home and abroad who has given a comprehensive account of the works he has carried out; and his monograph will not only be found of great value to engineers, but there is much in it that will interest all who have any concern in the government of towns and the welfare of their inhabitants. The book contains 291 pages and about sixty plates, besides portraits of the author in 1859 and 1884, the period through which it has been in his hands, his connection with the Manchester water supply dating back fifteen years earlier than the first of these dates.

The first parts of the book are historical, and are of much interest, as showing how even the practical inhabitants of a town like Manchester may be imposed upon by the promoters of a private company. In 1808 two public meetings were held concerning the water supply, and a committee was appointed by resolution for taking into consideration two schemes for the supply of Manchester from the Irk and the Medlock, the resolution suggesting that the management of the water supply should be in the hands of the inhabitants, to whose advantage the profits should be applied. In 1809 the committee drew up and presented a report briefly describing two schemes, one of them proposing to take the water from the Irwell—a fact which shows that little apprehension then existed concerning the rapidity with which the growth of manufactures on the Irwell banks would convert that river into a sewer. The other proposed to take water from the Larne at the Dukinfield Weir by canal. The committee believed either of these schemes preferable to those proposed by the private companies, and entered fully into the means of raising the money by the town and the management of the works by and for the inhabitants. One of the private companies, however, succeeded in carrying its Bill in opposition to the town. This was the Manchester and Salford Waterworks Company, commonly called the Stone Pipe Company. "Then," says Mr. Bateman, "commenced the perpetration of one of the most barefaced and nefarious pieces of jobbery which has ever disgraced the annals of private companies, replete as they are with instances of dishonesty." For many years the general body of the proprietors of this company and the town of Manchester were given over to the tender mercies of a small body of men who were the owners of a quarry of oolitic sandstone, from which they manufactured pipes under a patent granted to Sir George Wright in 1805 for cutting pillars or tubes from wood or stone. It was with a view of extending the sale of their pipes that they projected the waterworks, and as a first step to prevent competition they agreed with Sir Oswald Mosley, the Lord of the Manor, for the purchase of his interest in the small waterworks which then existed for £624 10s. 1d. It was this company so inaugurated that carried its Bill through Parliament in spite of the opposition of the town. Things were so arranged that the few owners of the stone pipe company secured £14,000 for their part of the affair, and remained proprietors in the waterworks company, the latter being adroitly made to pay a second time—though not at all to Sir Oswald Mosley—for the original waterworks; even the rent which had been agreed for, and which the stone pipe company ought to have paid to entitle it to sell the concern, being transferred to the waterworks company. Enormous prices were paid for the stone pipes, 18in. being 45s. per yard; 12in., 30s. 9d.; 6in., 11s. 6d.; and 3in., 4s. 11d. per yard; iron pipes being at the time 30 per cent. cheaper, and soon after 70 per cent. cheaper. The company got into difficulties, it need hardly be said; the pipes were paid for long after they had been found wholly unable to stand the pressures, and it was not until the money was gone and the company £50,000 in debt that the clique of directors interested in the stone pipes ceased to order and pay for stone pipes. Towards the latter part of the history of this clique there were only four members of it on the directorate, and yet they managed to hold their own until not another penny could be got. Manchester found itself in a very awkward predicament, but was almost powerless, as it had no power to expend money in opposing in Parliament any set of individuals, however much harm they might be doing.

In 1821 the company had to apply for power to raise more money, and in 1823 for an Act for constructing large reservoirs n Gorton, about four miles from Manchester, which had rapidly increased in size. Up to this time the waterworks had consisted of a couple of small settling ponds at Beswick, into which water from the Medlock was received, and a larger reservoir, about seven acres in extent, into which water was pumped from the settling ponds by a single-acting Bolton and Watt engine of 45-horse power. Upon these works the company had managed to throw away between 1809 and 1823 no less than £228,000, and had not paid a single dividend. The Gorton works were completed about 1826, and the water conveyed to Beswick by three miles of 18in. cast pipe. They were constructed under Nicholas Brown, of Wakefield, but they had to be materially altered by Simpson, who subsequently became engineer of the works. In 1831 the company first paid a dividend. Up to this time a rain gauge, except in the hands of a philosophical observer, was unknown, and all work involving hyetological questions was done by rule-of-thumb. In 1835 the author, with Fairbairn, was engaged by the millowners to prepare plans for the Bann reservoirs, for which an Act was obtained in 1836, and the works completed in about three years under the author. Here the author commenced a series of observations on rainfall, evaporation, &c., which he pursued also elsewhere. Meanwhile observations had been made with rain gauges on house-tops, and published under the authority of Dr. Dalton; but although these were useless, a good deal of opposition to the fact that less rain falls on the top of houses than on the ground had to be overcome by those who carried out under proper methods rainfall observations in various places, and some time subsequently the fact that less rain fell in the valleys than on the hills was ridiculed.

Mr. Bateman's first connection with the Manchester water supplies commenced in 1844, when he was called upon to advise upon the best means of obtaining a new and ample supply for Manchester. He had by this time collected and systematised extensive observational information of the rainfall and character of the surrounding country, and was ready to send in an exhaustive report, accompanied by a scheme which, though not immediately followed, has since been carried out. Compensation claims on the part of the millowners at the time were so heavy that the company was afraid to undertake the burdens imposed, and withdrew the Bill lodged. Other projects were started, and the Manchester Corporation stepped in and opposed. After this, amongst others, the Manchester, Sheffield, and Lincolnshire Railway Company promoted a project for applying the surplus water of the Peak Forest and Macclesfield Canals to the supply of Stockport, Manchester, and Salford. This was subsequently dropped by arrangement with the Corporation, who promoted new Bills in 1847 and 1848 empowering them to create new works and purchase the existing works of the old company. The Corporation became possessed of the latter in 1851, and Mr. Bateman was engineer of the new works. Under him the first works undertaken were the Woodhead Reservoir and the Mottram Canal. From this time the history passes into that of the works executed, and the second part of the book is descriptive of the new works. We cannot follow the author in his account of the construction of the several reservoirs, and the difficulties that were met with in the tunnel in consequence of a bed of quicksand. The account is not only interesting, but contains a great mass of descriptive facts of high value relating to the distributing pipes and mains and all the arrangements for control of the water for domestic, manufacturing, and fire uses. Results of experiments on the flow of water through pipes under different heads are given, and through gauge plates, with a view to determination of the quantity of compensation water given to different mill courses. The author does not, however, enter into any of these questions from a general theoretical point of view; nor upon any abstract hydraulics as concerns waterworks generally.

Much valuable information on different kinds of water and their effects is also given. An account of the Thirlmere scheme forms the latter part of the text, with the exception of several appendices, which give more fully the details of the history of old Manchester and its water supply, of the stone pipe company, reports on the rainfall observations and the methods of conducting them, gaugings of rivers and brooks, reports on projects, and general instructions of the Corporation Waterworks to authorised plumbers. The plates comprise maps of the watershed and supply areas, diagrams graphically showing rainfall over years, plans of the reservoirs, and drawings of the whole of the works, embankments, weirs, apparatus and machinery of all the existing works. The Thirlmere Works being in progress are not illustrated, except by plans of the reservoir, lake, and map of the district through which the aqueduct will pass. The plates are in every respect well executed, and the whole book is worthy of the great works which it describes, and which are a monument, to the skill of their engineer.

COMPOUND LOCOMOTIVE—WEBB'S PATENT—FOR THE COMPANHIA PAULISTA.

We illustrate on page 280 a Webb's patent three-cylinder compound engine, constructed by Messrs. Sharp, Stewart & Co., for the Paulista Railway. This line is situated in the interior of the province of Sao Paulo, Brazil, commencing at the terminus of the Sao Paulo Railway, at Jundiahy; and as the coal for the use of the engines has to be imported from England and conveyed inland, it will be readily understood that economy of fuel is one of the first considerations. Mr. Hammond, the engineer of the line, therefore desired to make a trial of Webb's compound system; and the engine now illustrated was ordered, the contract being placed in the hands of Messrs. Sharp, Stewart, and Co., who had already supplied the company with bogie passenger engines which had given excellent results, duplication with these engines as far as possible being kept in view. In designing the compound engine, therefore, the builders retained as many as possible of the general features and details of the former engines, while introducing the three-cylinder arrangement, using the bogie as before, and duplicating the boiler and many other principal parts. As regards the compound arrangement, it is similar to that of the London and North-Western compound engines, which need hardly be again described The leading dimensions are:—

Gauge of line	5ft. 3in.
Cylinders, diameter of high-pressure	0ft. 11½in.
Stroke of high-pressure	1ft. 10in.
Diameter of low-pressure	2ft. 2in.
Stroke of low-pressure	2ft. 0in.
Wheels, diameter of driving	5ft. 6½in.
Diameter of bogie	3ft. 1in.
Wheel base fixed	7ft. 9in.
Wheel base total..	20ft. 3in.
Boiler, length of barrel	10ft. 4in.
Diameter of barrel	3ft. 10⅜in.
Number of tubes, brass	156
Diameter of tubes outside	2in.
Heating surface, fire-box and midfeather..	99 sq. ft.
Tubes	870 sq. ft.
Total	969 sq. ft.
Grate area	16·75 sq. ft.

In a further impression we shall give additional drawings.

THE ANTWERP EXHIBITION.

No. VI.

Hardly, if at all, second in importance to the display of the Société Cockerill, which we have already described, is that made by Messrs. Claparede and Co., of St. Denis. This is one of the most eminent engineering firms in France, old-established, and possessing a high reputation. The exhibit of the firm consists of the complete machinery and boilers of the armoured gunboat Phlégéton, and possesses the highest interest, because it is of the very latest type, and is in many respects a wide departure from normal practice. We are enabled, through the courtesy of Messrs. Claparede, to place before our readers a complete set of illustrations of the machinery of the Phlégéton, the publication of which we commence this week.

The stand of Messrs. Claparede and Co. occupies a conspicuous position near the centre of the Machinery Hall. On a slightly raised platform, which may be taken to represent the floor of the engine and boiler-room of the Phlégéton, are placed the boilers and engines, just as they will stand in the ship, and at the end of the platform are the two four-bladed gun-metal screws. No attempt has been made, however, to reproduce the sides of the ship. On page 276 we give a general view of the whole in place in the ship, with various cross sections. It will be seen that she lies low in the water and is armoured, but the details of the armour are not made public. The draught of the vessel is 11ft. 6in., her beam being nearly 40ft. The engine-room is 27ft. 7in. long; the boiler-room 31ft. 6in. Steam is supplied by four boilers of the locomotive type, with a large steam drum on the top of each. They are each 19ft. 8in. long and 4ft. 7in. diameter. On page 277 will be found an enlarged view of the boilers. The annexed table gives the principal dimensions of each:—

Boilers of Phlégéton.

Heating surface of fire-box	108 square feet.
do. do. of tubes...	796 square feet.
Total do.	904 square feet.
Grate surface	21·5 square feet.
Calorimeter through ferrules of tubes...	2·50 square feet.
Cross section of uptake to chimney ...	3·55 square feet.
Number of copper tubes...	217
Diameter of do.	1·57in. + 1·73in.
Normal pressure	86 lb.
Water space	164 cubic feet.
Steam space	124 cubic feet.
The boilers will carry with safety when pressed	114 lb. per sq. in.

It will be seen that the boilers and engines are duplicates throughout, entirely independent of each other, and separated by a water-tight longitudinal bulkhead. There are also transverse bulkheads. The space occupied in the breadth of the ship by each pair of boilers is only about 10ft. 4in. The space between the boilers and the ship's side is stowed with coal, occupying a space about 7ft. 3in. wide, and affording considerable protection. The ship has a very wide space between the external and internal skins, the frames indeed being not less than 2ft. 6in. deep. The boilers are worked with forced draught, the air being driven in by two independent fans placed inside the aftermost boiler-room bulkhead, as shown. An air-lock is provided in this bulkhead to give access to the stokehole. At each side of this last is placed a donkey pump within a recess in the coal bunker, as shown very clearly in the cross section. The air fans draw in at the centre and discharge at their circumference into the stokehole. They are driven each by an independent engine. The arrangement of the boilers, and the design and workmanship of all the fittings, leave nothing to be desired, being quite equal in every respect to anything to be found in our own Navy.

The engines are horizontal direct-acting; they have nothing to do but drive the propellers; all other functions, such as working the air pump, being performed by entirely independent compound engines, which we shall illustrate in a succeeding impression. The diameter of the high-pressure cylinder of the main engines is 26in.; that of the low-pressure cylinder, 45in.; the stroke, 19¾in.; number of revolutions, 160 per minute. The screw propellers are of gun-metal, finished all over the faces by means of a rotating tool somewhat similar to a slot drill, which appears to be a much better method of getting up the surfaces than filing, as practised in this country. The engines are admirably designed and are very handsome. Balancing has been carefully attended to, and the method adopted of securing the balance weights by a dovetail is well worth examination. The connecting-rods are 39¾in. long centre to centre, or no less than four cranks, a very favourable proportion. The slide valves are balanced, and there is Meyer's cut-off valve to the high-pressure cylinder. Reversing is effected by a Stephenson link motion. The crank pins and crank-shaft are 7½in. diameter. The crank pins are 11·8in. long. The forward main bearing is the same length as the crank pins, but the two aft bearings are each no less than 18in. long. The engines are so placed in the ship that the screw shafts diverge as they approach the stern. The propellers are 9ft. 3in. diameter. We do not know the pitch. We shall reserve what we have to say further until we can publish engravings of the remainder of the machinery of the Phlégéton.

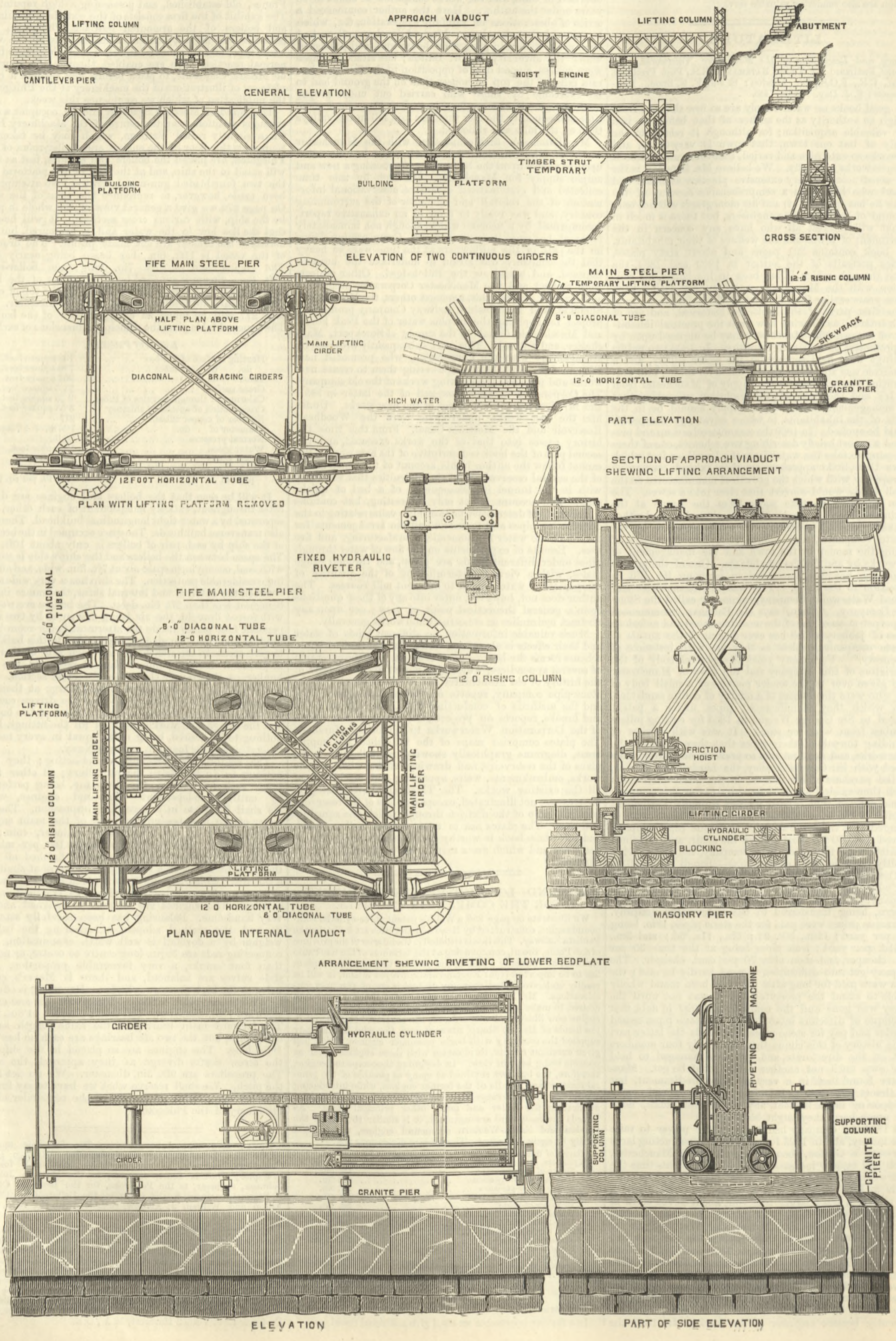
Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—George R. T. Cummings, engineer, to the Pembroke, additional, for the Warspite; Thomas Scott, engineer, to the Hector; John E. Johnson, engineer, to the Pembroke, for the Benbow; Charles E. Stewart, engineer, to the Indus, for the Bellerophon; Charles Allsop and William J. Andrew, engineers, to the Asia, additional.

The University College, London.—The session 1885-86 in the department of Applied Science and Technology of this College has commenced. The Engineering and Mechanical Technology is under Professor Alexander B. W. Kennedy, M.I.C.E., who will give a series of ten special weekly lectures "On Mechanisms," commencing at 6.15 in the evening, for the convenience of students engaged in business during the day. These lectures will be illustrated by diagrams and models, and will commence on Tuesday evening, the 13th inst. The Civil Engineering courses are under Professor L. F. Vernon Harcourt, M.A., C.E.

ERECTING THE GREAT FORTH BRIDGE.

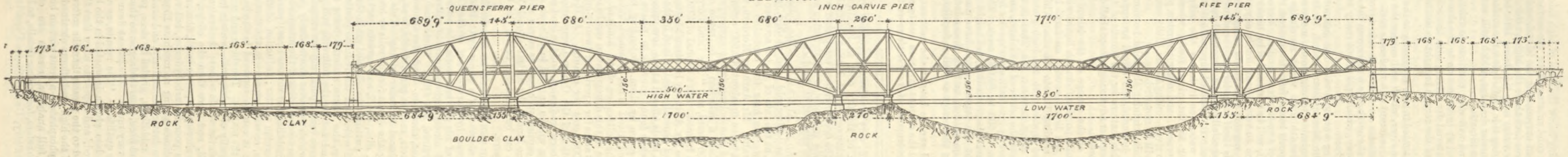
MESSRS. BAKER AND FOWLER, MM.I.C.E., ENGINEERS; MESSRS. TANCRED, ARROL AND CO., CONTRACTORS.

(For description see page 285.)

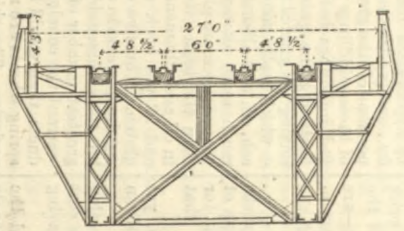


THE BRIDGE OVER THE FORTH.

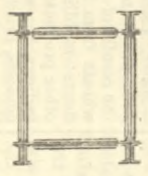
ELEVATION



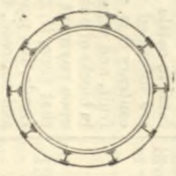
CROSS SECTION OF ROADWAY

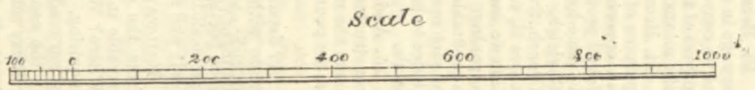


UPPER TENSION MEMBER

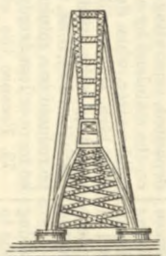


BOTTOM COMPRESSION MEMBER

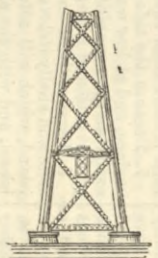




CROSS SECTION AT CENTRE



CROSS SECTION AT PIER



THE FORTH BRIDGE.*

PROPOSED METHOD OF ERECTING THE MAIN STEEL PIERS AND APPROACH VIADUCTS.

By Andrew S. Biggart, C.E.

Works of exceptional magnitude, and more especially those in which the difficulties in the way of their accomplishment are in any degree proportionate to their size, must of necessity be of interest to this Association, constituted, as it is, to assist, and in its own way act as a beacon to all in search of true knowledge. While the difficulties met with in preparing for and founding the piers of the Forth Bridge have been neither few nor unimportant, it is patent to even the uninitiated that causes for anxiety will neither disappear nor diminish till the erection of the steel superstructure has been completed. Presently our remarks will be confined to the main steel piers and approach viaducts. The term steel piers refers to those parts of the superstructure immediately over and between any of the three groups of four caissons. Described generally, each may be said to consist of two sloping and two vertical planes, the sloping including one connecting horizontal column and two 12ft. rising columns, joined at the upper extremities by the top member, while from the lower end of each to the top of the opposite one there extends a diagonal 8ft. tube. These two planes run parallel with the centre line of the bridge, and are 120ft. apart at the base and 33ft. at the top. The vertical planes complete the structure at the ends of the two sloping planes. They consist of the 12ft. rising columns already mentioned, with the lattice bracing joining these together. These members, with the internal viaduct and the bracing girders attached to the skewbacks, form the principal parts of the steel piers, the extreme height of which is fully 340ft. above the bottom of the lower bed-plates.

The approach viaducts are, generally speaking, of ordinary design, with the exception of some special features to meet the unusual requirements demanded of them. The girders span a distance of 160ft., and rest on granite-faced piers, rising to a height of 130ft. above high water; the heights of these piers themselves gradually diminishing as they near the abutments, owing to the rising nature of the banks of the river. The magnitude of the main steel piers, both in respect of their great height and immense weight, demands that exceptional means be employed in their erection. Many proposals for effecting this have been suggested, and may be said to range from that of Mr. Arrol's first, which was to run up the columns independently, using them as the only staging, to that proposed by Mr. Baker, viz., to carry up simultaneously with the columns a rising platform, extending round the whole four columns, by utilising them as supports, and upon this platform to carry up the top member, having the end junctions all previously rivetted up, so that on arrival at the top, the final closing lengths of the 12ft. rising columns had only to be joined to the junctions already fitted to complete this part of the work. After careful consideration, the weight requiring to be lifted was found to be too great, when compared with the advantages to be gained, to allow of its full adoption. In the case of the Fife and Queensferry piers the weight was close on 1200 tons, and several hundred tons more in that of Inch Garvie. A modification of this plan is that finally adopted by Mr. Arrol, with Sir John Fowler and Mr. Baker's full approval. The carrying up of the top member is done away with, but otherwise it is very similar. The engravings on page 284 illustrate the pier and this platform. The main lifting girders of the platform pass through the 12ft. rising columns, and running in line with the vertical planes, extend from the one sloping plane to the other. Lying across these are placed other four girders, one being on either side of each set of 12ft. rising columns, thus completing a rectangular platform resting indirectly on the main rising columns. The weight of this platform, including the necessary cranes and other plant required during the erection of the higher parts of the pier, will be about 400 tons.

The first part of the superstructure is that termed the lower bed-plate. Several of these are now completed and in position. They are made up of a series of longitudinal and transverse plates securely rivetted together, and run about 37ft. long by 17ft. 8in. wide, with a thickness of from 3in. to 4in., as seen in the engravings of lower part of page 284. The whole plate is bolted on a number of short iron columns *in situ*, and is rivetted up by a special hydraulic machine. Two girders are employed, one above and the other below the bed-plate, and extending beyond it are there joined together. On each of these girders slides a hydraulic cylinder, one having a little more effective area than the other, while both are regulated by the same cock. The result is that when water is admitted the total pressure on one cylinder is greater than that on the other, thereby holding the rivet head firmly in place while the point is being pressed up. The work thus produced is of the very highest quality. Since the whole machine moves lengthwise and the cylinders slide crosswise, the full surface of the plate is commanded by it. The rivetting is also done expeditiously, the machine being capable in ordinary work of closing during a single shift 600 1¼in. countersunk rivets. When finished the bed-plate is finally lowered into position. The upper bed-plate, or base on which the various connections at the foot of the rising column rest—and which collectively constitute what is termed the skew-back—is proposed to be rivetted in a like manner to the lower bed-plate. While being rivetted it will be secured to heavy steel girders, instead of columns, as in the case of the lower bed-plate, to keep it in true form. After lowering the upper bed-plate into position, the diaphragms and various other parts will then be built on it, and rivetted up by common hydraulic machines, as well as by the special hydraulic machines designed by Mr. Arrol for the purpose. As many of the spaces in which rivetting has to be done are very confined and difficult of access, high pressures will be used with machines correspondingly small; thus while the ordinary pressure will still be 1000 lb. per square inch, it will be increased in some cases to as high as three tons per square inch by a simple pressure multiplier wrought by the ordinary 1000 lb. pressure. This low pressure is admitted to the large end of the compressing ram, the smaller end of which produces the increased pressure—proportional to the difference in areas—required to close up the rivet properly. The rivetting machine is very small, each cylinder weighing about half a hundredweight. The smallest proposed cylinder is only 4in. diameter, is of the simplest form, and contains a hollow plunger provided with a single cup leather at the inner end. A spring is secured to the plunger and back end of the cylinder for the purpose of drawing back the plunger when the exhaust water is allowed to escape. When in place and at work the machine will be hung to the one end of a small wire passing over of a pulley, while at the other will be fixed a balance weight to relieve the operator of the weight of the machine. Two cylinders, one outside and one inside, will be required at the closing up of the rivets; both will be connected to the compressor and wrought by it. The horizontal tubes, skewbacks, and lower parts of all the columns will be built by ordinary cranes till they attain a height of about 30ft. above the bed-plates. At this point of the 12ft. rising columns will then be commenced the longitudinal channels—through which are drilled the holes for the steel pins to pass through them and the cross girders—to these channels the cross girders will now be attached within the column, on the higher of which will be laid the two main lifting girders of the platform. Extending between and beyond these, but at right angles, will be the other girders required to complete the rectangular platform already referred to. The principal work above this will be executed from this platform, as it is being raised towards the top of the pier. In that work will be included the 12ft. rising or supporting columns, the 8ft. diagonal columns, and the bracing in the sloping planes. The vertical planes will be built similarly as the platform is raised upwards. When all is ready to be raised for the first time the positions of the various members in the pier will be somewhat as follows: The four rising 12ft. columns will have the whole of their channels, and eight of the ten plates in section, in each column at a convenient working height above the platform. The other two plates require to be kept off at this point to allow the main lifting girders to pass through the columns, and can only be placed in final position from underneath the main lifting girders. The columns will only be bolted together at this point, but as few more bolts will be required than those necessary to make good work when rivetting up, very little labour will be lost. The 8ft. diagonal tubes in the sloping planes will also be carried up above the level of the platform. They pass between the girders and lie in the sloping planes, and will be wholly rivetted up above the level of the platform. The bracing in the vertical planes being 12ft. wide, allows the main lifting girders to pass through it, and will be built to a large extent from a platform on the top of these girders, only the top and bottom bracing requiring to be placed and rivetted in position underneath the main lifting girders. While the whole of the tubes will be built in single pieces, in the case of the bracing girders, it is intended to take up and fix in position sections of a size convenient for handling with despatch under the somewhat novel circumstances around.

(*To be continued.*)

* British Association, Aberdeen.

THE QUETTA RAILWAY.

Very considerable interest is felt in the progress of the railway to Quetta, the completion of which is rightly considered the first step necessary for the sufficient execution of the new schemes of defence on the western frontier of India, and we are in a position to describe the exact state of the railway now in course of construction from the extreme limits of Scinde into the Pishin Valley. The title of this line has varied, during the six years that have elapsed since it was first projected, with the ultimate intentions of its official promoters. Its earliest designation was the most ambitious, for it was then termed the Candahar State Railway, but in its present form, which will very shortly be practically completed, it is called the Scinde-Pishin State Railway. We have preferred, however, to consider this railway as the line to Quetta, which, although there is some talk of superseding it as our principal military station, is still the most important strategical position on the Indian frontier. To prevent misconception, it may be stated that Quetta is not on the main line to the Pishin Valley, which must inevitably be continued before very many years pass by to Candahar, but it will be connected with it by a loop line from Bostan. In order to make the subject perfectly clear, we will begin with a sketch of the earlier history of the line, which will reveal the evil consequences of the four years' delay in completing it that followed the determination of the late Cabinet to suspend operations in this direction.

The first order of the Government of India for the construction of a railway in the direction of Sibi from Rukh, a station on the Indus Valley Railway near Sukhur, was given on the 11th of September, 1879. That order stated that "the gauge of the railway was to be the standard one of 5ft. 6in., and that it was to be laid as far as practicable on the surface without ballast." Nine days later Government came to a further decision. They decided that "from the terminus of the broad-gauge line a cart road should be made up the Bolan Pass, and on probably to Quetta and Pishin," and, further, that on this road "a 2ft. tram, to be worked by steam power, should be laid." Fifty lakhs were granted for the railway, and 26 lakhs for the road and tramway materials, and the Viceroy, Lord Lytton, requested that 200 miles of metre-gauge permanent way might be sent out from England. This was done at a cost of about £150,000. One month later the Viceroy asked for 200 miles more of the same material, with girders, engines, and rolling stock, as well as broad-gauge materials. The total cost of this further order was £420,000. An official telegram, dated October 21st, 1879, described these works as being in active progress. It will simplify matters if we point out that at this period it was assumed that the railway to Quetta would be laid down through the Bolan Pass, and consequently the preliminary measure was to construct the line as far as Sibi with all possible expedition. Two months later Sir Richard Temple, who had been pushing forward the line in the plain with characteristic energy, reported in favour of a route to Pishin and Candahar, north and north-west of Sibi, and passing through Hurnai and Gwal. This route was then adopted for a railway in preference to the proposed tramway through the Bolan. In June, 1880, the line was in use for 140 miles, from the Indus to the Murree Hills, north of Sibi. Beyond this the Nari river section was in active progress, while 100 miles of service road to the Quetta plateau were nearly complete, and a further section of 50 miles to the Amran range was under survey. Such was the exact position of this important line in 1880, when the change of Government occurred at home.

Lord Hartington's first act in connection with this question on coming into office was to authorise the completion of the surveys to the Amran range and as far as Candahar, but to order that "nothing further should be done on either of these two sections towards the construction of a railway without previous reference" to the Home authorities, adding that "in the event of her Majesty's Government deciding not to maintain permanently a military force at Candahar the completion of the surveys of these sections of the lines will enable me to arrive at some conclusion as to the most appropriate terminus for the railway." Four months later—October, 1880—the Viceroy—Lord Ripon—telegraphed:—

"We have decided to make Candahar railway only as far as Gulistan Karez, and will therefore not change gauge from broad. Order at once 50 miles of permanent way, ordinary broad-gauge type, complete with sleepers, and twenty light engines. Despatch follows with full indent."

Let it be said parenthetically, for the sake of clearness, that Gulistan Karez is at the extremity of the Pishin Valley, near the passes over the Amran range, and that it is quite impossible for us to have railway communication with this place before 1887. Yet the Viceroy proposed to press on the railway to it in October, 1880. Lord Hartington's reply in the name of the Cabinet to Lord Ripon's request for 50 miles of material was sent in a telegram on October 21st, 1880:—"Further information required before indents can be sanctioned." Three days later he asked for information by telegraph as to "extent completed of Candahar railway, also estimated time of finishing it to Quetta and Gulistan." To this inquiry the Viceroy replied as follows:—

"Line practically complete, with temporary bridges, to foot of Bolan and Nari Gorge. Distance in all about 165 miles; permanent bridges and ballasting in progress. For 30 miles from Nari Gorge into Hurnai Valley at Spintangi earthworks more or less finished; bridges not commenced, but girders at Sibi. From Spintangi to Quetta service road for country carts made for whole distance except two miles through Chappar Rift; railway works in this length only lined out. Nothing further done towards Gulistan, but works known to be light. Expenditure to end of 1879-80, 90 lakhs; expenditure already sanctioned and mostly spent for 1880-1, 160 lakhs. Probable future expenditure about 150 lakhs. Grand total about 400 lakhs from Indus Valley to Gulistan Karez. These figures include home charges and about £800,000 for indents about to be submitted for broad-gauge stock and materials, but are subject to a reduction of £600,000 for previously purchased metre-gauge material now available for use on other railways. Expenditure does not provide for railway beyond Gulistan."

A few days after the receipt of this telegram the Secretary of State decided that he could not sanction the completion of the line to Gulistan, and from that date until the Russian occupation of Merv nothing whatever was done to continue the line beyond Nari or to improve the means of communication through the Bolan. Some of the material collected was diverted to other lines, the whole of the works begun were suspended, and four precious years were allowed to pass away without the addition of a single mile to the most important strategical line in British India.

It is not easy to state with any degree of accuracy the cost entailed by the abandonment of the line in 1880, for the only estimate received was that contained in the telegram previously quoted, which fixed the total cost at 400 lakhs. A fair statement of the case seems to be that the estimate was not sufficiently complete to enable a judgment to be formed of the exact amount which had been expended when the operations were discontinued. The 400 lakhs included the cost of the Sibi line—about 150 miles in length, with the branch to the foot of the Bolan—which may be taken at 150 lakhs, and also about 50 lakhs' worth of material diverted to other lines. The greater portion of the future expenditure of 150 lakhs may also be deducted, as the order for stopping the work was given very soon after the date of the telegram. Moreover, no account has been given of the condition in which the abandoned works were left, or of the state in which they were found when operations were recommenced in 1884; but it may be presumed that the cuttings and embankments were left in a serviceable state, and the girders and rails left on the spot would also be of use. The loss incurred will therefore lie between the 50 lakhs unaccounted for and the value of the work and materials remaining at the time of recommencing operations. This view is corroborated by the official statement in the Budget of 1881 that 55 lakhs had been charged to military operations on account of the abandoned section of the Candahar Railway. The loss may, therefore, be computed at about half a million sterling, but even this considerable sum must be deemed a minor loss to the sacrifice of four years in point of time.

It seems almost incredible, but it is none the less a fact, that the official history of this line is a complete blank from October, 1880, till April, 1884. At the latter date the Russian occupation of Merv was not merely authenticated, but it had forced upon the minds of those Ministers who had stopped the line in 1880 the conclusion that it was absolutely necessary to resume what had been abandoned, and to push on railway communication with Pishin. On April 24th, 1884, Lord Kimberley addressed a despatch to the Government of India stating that he had decided that the construction of the line from Sibi to Quetta should be recommenced, and desiring that measures might accordingly be taken without any delay. The matter was considered so urgent that the substance of this despatch was telegraphed to the Viceroy. The Viceroy's reply—not only to the telegraphic summary of this despatch, but also to an earlier inquiry for information in January of the same year—dated May 6th, 1884, stated that measures were being taken for as speedy a prosecution of the works as the nature of the country and the trying changes of climate would permit. Bridge-work and permanent-way materials were requested by telegraph, and authority was solicited for a branch line of ten miles from Bostan to Shebo, in the Pishin Valley, and in the direction of Gulistan Karez. This request was complied with, and every effort was made to expedite the despatch of the required material to India. Estimates of the cost of the Scinde-Pishin State Railway, which did not include the expenditure in the Bolan Pass, were subsequently received, and they amounted to 265 lakhs, to be distributed as follows:—

1883-4	12¼ lakhs.
1884-5	74 lakhs.
1885-6	85 lakhs.
1886-7	75 lakhs.
1887-8	18¾ lakhs.
Total	265

From this statement it will be perceived that the line to Shebo was expected to be finished during 1887. We may now describe the amount of the work accomplished since the recommencement of the line.

At the end of October, 1884, the whole of the earthworks from Hurnai to Garkhai—a distance of 65 miles—had been completed, with the exception of the heavy cutting at Mud Gorge and some less difficult portions. More than half of the tunnel headings of the Chappar Rift had been driven through, material for most of the bridges had been collected, and the final portion of the line to Quetta, *i.e.*, from Bostan to Quetta, had been planned and marked out. In reply to the Secretary of State's instructions that "the line should be completed with the utmost possible speed consistent with economy of construction," the Viceroy replied that the line might be expected to be completed in the official year 1887-8 "if funds are regularly forthcoming and other conditions are favourable." In the spring of the present year various reasons made it appear desirable that, while the main line was in progress beyond Hurnai, something should be done to improve communications with Quetta through the Bolan Pass. The reader will more easily grasp the difference between these two lines if we state here that by the direct route Quetta is 80 miles distant from Pir Choki, the last station built in 1880, and situated at the entrance to the Pass, while it is 146 miles from Nari, the last station built in the same year, *viâ* Hurnai, Chappar, and Bostan. The Viceroy sent the following telegram on this subject at the end of April:—

"In order to relieve transport in lower part of Bolan Pass under present circumstances, we have sanctioned the temporary extension of the existing line from the entrance of the pass as far as Mach, or about fifty-two miles, and also expedients by winding engines probably seven miles further to the summit of the pass, where junction with the Scinde-Pishin line will be effected. Work under Colonel Lindsay began April 20th and is being prosecuted actively."

This telegram was followed by another to this effect:—

"Under present circumstances we consider it indispensable to extend this line from Quetta back to the top of the Bolan Pass and also from Shebo to the foot of the Amran range."

All the Viceroy's proposals were sanctioned by the Secretary of State in Council, and immense quantities of railway material were sent out from England. In consequence of this increased activity the Government of India expected in May that the line might be ready for traffic as far as Sharigh, seventy-four miles from Sibi, in the course of the present month, and as far as Durgai, twenty miles further on and at the foot of the Chappar Rift, by the end of November. But progress depended upon the completion of bridges, as the carriage road was not practicable for girders and permanent way material. The line has had to be laid down telescopically. The realisation of these expectations may have been interfered with by the excessive heat, as well as by the exceptional floods, and no intimation has yet been received that the line will be finished as far as Sharigh by the 1st of November; but the skill and perseverance of Brigadier-General Browne, the engineer-in-chief, receive the warmest commendation of the Viceroy in Council. It may be anticipated with some degree of confidence that the line will be ready to Durgai, ninety-four miles from Sibi and more than half-way from that place to Quetta, by the end of the present year.

The difficulties of constructing this line will be gathered from the fact that during the summer months much of the country through which it passes is uninhabitable. The labourers have suffered from several serious visitations of fever and cholera, and in January an extraordinary flood of the Nari river destroyed much of the work which had been accomplished during the two previous months. The importance of this stream may be inferred from the fact of its being bridged no fewer than six times in the course of a few miles. In the cold weather the lower part of the line—that is, for 40 miles from Sibi—was worked upon, and in the hot weather the upper section from Hurnai to Garkhai, the latter of which places is situated at the mouth of a defile opening out on the Pishin plateau. It is also 33 miles north of Quetta. The chief engineering difficulty between Hurnai and Garkhai is the Chappar Rift, which has been already mentioned. It has been thus described:—

"The Chappar Rift is a fissure in the mountains some 2½ miles in length, through which a mountain torrent forces its way among enormous boulders until, issuing at the lower end of the rift, it flows almost at right angles to the direction of the rift down the Khost Valley to Sharigh. At either end of the rift this stream passes through a narrow gorge, in some places only a few feet in width, the rocks rising perpendicularly on either side to a height in some places of more than 200ft. In the centre—*i.e.*, between these gorges—the rift opens out to an oval shape, the sides being formed of *débris* of rock and shale. Through this rift the railway has to pass, and as the longitudinal slope of the rift is about 1 in 20, and the maximum gradient of the railway 1 in 45, it is evident that to effect an exit at the upper end the line must enter the lower end at a very considerable height."

This difficulty has been met by some tunnelling, and by taking the line for a certain distance up the valley, while the gorge is to be spanned by a high-level bridge. At the upper end of the rift there are several tunnels, one being of 1800ft.; then a long cutting through rock, and finally a second tunnel of 400ft. The tunnelling has been successfully accomplished with the aid of dynamite, and only one accident occurred. The northern extremity of the Chappar Rift works is at Mangi, and about half-way between that place and Kach is the second most serious engineering obstacle encountered along the line. This is at a place called Mud Gorge, from its dirty appearance. The original plan was to get over this part of the route with several tunnels and bridges; but the course pursued, after a more careful survey, has been to dispense with the tunnels and bridges, and to overcome the difficulty by means of a cutting, which is described as probably the stiffest throughout the whole of the line. Once at Garkhai, which is the station beyond Kach, the descent to the Pishin plateau is rapid, but in order to cross the crest of the mountains between those two places recourse has had to be made to a spiral railway—a fact described as unique in the history of Indian railways. From Garkhai to Quetta there are no serious difficulties, and the only bridge of importance will be the one across the Lora stream, eight miles from the latter place. The work has been carried on under the direct supervision of Brigadier-General Browne, and the majority of the labourers come from Scinde. At Sharigh there is a permanent garrison of infantry and cavalry. Mangi, 22 miles further on and north of the Chappar Rift, has been the quarters of four companies of Bombay Sappers; while Kach, 14 miles distant from Mangi, is occupied by the 1st Madras Pioneers.

Although it would be hard to over-estimate the disadvantage under which the Government of India laboured in its frontier defences and policy through the suspension of operations on this line in 1880, there can be no question of the energy which was devoted to the task once it was resolved to resume the work in the spring of 1884. The absence of the necessary materials, which had all to be sent out from England, involved no inconsiderable delay at the commencement, and the exceptional number of bridges which have to be constructed will remain a hindrance to rapid progress until the end. The floods of the Nari River not merely destroyed much of what had been done; they also discouraged the native labourers, who, having suffered from fever and cholera, were peculiarly susceptible to the adverse influences of dampness. Not the least difficult part of the task which General Browne has patiently and energetically directed towards a successful conclusion has been to keep the men in good spirits, and to prevent them from abandoning the work *en masse* in a moment of panic. When we add to this the natural obstacles of the country—a mountain region ascending 6000ft. in vertical height, which has to be pierced and crossed; the want of materials of the simplest kind on the spot, for the rock is unfit for building, and there is a complete absence of fuel; and the climatic conditions, which compel the work to be distributed over different periods of the year—it will be admitted that we may, without boasting, term this railway to Quetta and Pishin a great undertaking.—*Times.*

METROPOLITAN SEWAGE DISPOSAL.—PURIFICATION OF THE RIVER THAMES.

The following is a statement of reasons why Canvey Island should be utilised for the purification of the sewage of the metropolis which is being circulated by Colonel Jones and Mr. Bailey-Denton, in support of the memorial submitted by them to the Secretary of State on the 20th of July last, in which they proposed to clarify the sewage of the metropolis on Canvey Island, and relieve the Metropolitan Board of its treatment for forty years on payment of an annual subsidy of ¾d. in the pound on the rateable value of the metropolis. Colonel Jones and Mr. Bailey-Denton believe that the position of Canvey Island in relation to the metropolis, its proximity to the mouth of the Thames, its size and sufficiency for the cleansing of the sewage, not only of the metropolis but of the Lea Valley also; its special physical characteristics which favour in a very remarkable manner the separation of the solid portions of the sewage from the liquid; its affording ample space for any mode of treatment the Metropolitan Board may see fit to substitute, wholly or partially, for the proposal submitted, and particularly the comparatively low price at which the Metropolitan Board can acquire the freehold of the island in consequence of the opportune arrangements made—are all circumstances which they contend should command the attention of every one interested in the sanitary condition of the metropolis and the river Thames. The reasons are:—

1. Because the island, containing with its saltings and creeks 4500 acres, affords ample space for the adoption of a system of sewage disposal which will meet the requirements of London for 100 years to come, and will give scope for any modification that science may dictate, or future experience render desirable.

2. Because the island exists at the mouth of the Thames, yet within twenty miles of the Barking outfall of the metropolitan system.

3. Because the island can now be purchased at a moderate outlay—at much less, in fact, than one-half of what it would have cost twenty years ago—full seven-ninths of the whole extent having been secured without the exercise of compulsory powers.

4. Because the island is used simply for agriculture, and the dwellings are few and the population sparse. Such buildings as do exist, including the church and vicarage, are of timber construction, and may be removed and rebuilt at moderate cost.

5. Because the surface of the island is flat, and will not require any great outlay to prepare it for the reception of the solid portion of the sewage, which, being precipitated on the surface, may there consolidate without further removal, and become very productive land.

6. Because the surface being below the level of high tide, it will allow of the deposit of the solid substances on the surface to the height of the banks at present surrounding the island, and yet not raise it more than two or three feet above the highest tide.

7. Because the tide at low water neap tide being 10ft. below the surface, and at low water spring tide 12½ft. below the surface, there exists ample capability of under drainage, which will secure the perfect action of intermittent filtration.

8. Because there exists, and will ever continue to exist, beds of sand and shelly *débris* washed up by the sea on to the shores of the island, which will afford material for mixing with the soil of the island, and with the sludge of the sewage brought to the island for consolidation.

9. Because the island is situated in near proximity to the outcrop of chalk on both sides of the river, which will ensure the delivery of lime as a precipitant and deodorant at a moderate cost.

10. Because the island possesses on the south side a frontage to the river, and commands on the north side a station on the London, Tilbury, and Southend Railway, which will afford ready means of access for materials and produce.

11. Because the island being watergirt will, if it becomes in its entirety the property of the Metropolitan Board, be free from objection on the ground of nuisance to neighbours, inasmuch as it will command a marginal breadth upon which no sludge will be deposited, separating the deposit basins from the nearest residence on the mainland by a space of two-thirds of a mile. Moreover the solid matter, when deposited, will be surrounded by banks 10ft. to 12ft. high, which will confine to very narrow limits any effluvium that may arise, whilst the organic ingredients being chemically precipitated by lime, which is itself a deodoriser, the effluvium will be reduced to a minimum, especially as the deposited matter will be more or less deeply covered with clarified supernatant water.

12. Because the effluent water, as it leaves the island after separation, will be as clear as the river itself, whereby the objection of Southend, Gravesend, and other riverside places to the present condition of the river—owing to the filthy ooze which now rests upon its shores—will be removed.

13. Because the island, while retaining the solid portion of the sewage in earthen basins, as intended, will afford an opportunity of its conversion into a saleable manure for the benefit of the ratepayers of the metropolis, whenever advancing science shall develope the means of doing so with profit.

14. Because the detention of the sewage on the island for the purpose of separating the solid portion from the liquid will afford an opportunity of utilising the liquid sewage on farm lands, if found profitable, instead of sending it into the sea. This would be done by lifting the clarified liquid up to the high ground near Rayleigh, which forms the ridge between the Thames and the Crouch, five miles distant from the centre of the island, and 200ft. above it, whence it would flow by gravitation for service by irrigation to land extending from 60,000 to 80,000 acres. The great advantage which would attend this proceeding and might make it a profitable one would be that the tenants could have the sewage at such seasons, and in such quantities, as they themselves would desire to have it for watering their crops as well as fertilising their lands.

15. And because the island can be bought, the necessary works constructed and paid for, and the current expenses met by a charge upon the ratepayers of the metropolis of very little more than ¾d. in the pound.

At departure of recent mail, very satisfactory progress was being made with the construction of the dry dock at Esquimalt, the British naval station on Vancouver Island, British Columbia. A good portion of the walls of the dock had been completed when the last mail left; the caisson was in course of construction at Montreal; and about 125 men were engaged at the dock.

Railways and Cheap Land in Australia.—The following is from the *Colonies and India*:—Freehold land at 5¼d. per acre, payable in twenty-one years, at the rate of ¼d. per acre per annum! Where? Where? we fancy we can hear the capitalist excitedly inquiring. In Western Australia. Mr. Anthony Hordern, as many of our readers are aware, has taken up about 500,000 acres of land in the south-west section of the colony, in connection with his railway scheme, and has caused a selection to be made of other areas—in all, nearly 3,000,000 acres, and "The Land Corporation of West Australia" has been formed, with a capital of £100,000, in shares of £5 each, to purchase Mr. Anthony Hordern's interest, and to acquire, lease, improve, and generally deal in land in the Colony of Western Australia. The lands offered at the low price of 5¼d. per acre are those upon which is found growing in places a shrub fatal to cattle and sheep if eaten by them. Intending investors are informed that "the land itself is not poisoned, but on the contrary it is suitable for the cultivation of all kinds of cereals, fruit, and vegetables. Lands of this denomination can be obtained in blocks of not less than 1000 acres for a period of twenty-one years, upon payment of 20s. per 1000 acres per annum. At the end of that time, if, to the satisfaction of the Crown Commissioners of Lands, the poison shrub has been eradicated, and the land surveyed and enclosed, the Corporation will be entitled to a Crown grant of the land in fee simple." Excepting such land as comes within the definition of poisoned lands, no land in the central—South-Western—district of West Australia can be purchased below the Government upset price of 10s. per acre.

Chemical Composition of the Products of Roller-Milling of Wheat.—The following abstract of a paper by C. Richardson—*Amer. Chem. J.* 6—is given by the *Journal of the Chemical Society*:—"In continuation of his previous work, the author gives the results of the analyses of ninety-eight samples of roller-milled wheats from Minnesota, Virginia, and Ohio. These include fine flours—middlings, patent flour, chop, &c.—and also the numerous other products and bye-products, such as germ, shorts, bran, cockle, tailings, &c., which are produced in roller-milling. This process consists, briefly, in preparing the wheat for the rolls or breaks, by the removal of foreign seed, dirt, chaff, and certain parts of the outer coatings of the grain; putting the cleaned grain through a series of rolls, after each of which all the reduced portion is removed and collected as chop, the coarse material being cleaned from all adherent matter and fed to the following roll, until it comes from the last one as mere bran; purifying the various chops by appropriate machinery, which removes shorts, dusty particles, &c., and grades the coarser part—consisting of the interior or floury portions of the grain—into middlings of various sizes; purification of these middlings from all foreign matter; reduction of the purified middlings between rolls, or with stones—in the first manner flattening the germ so that it can be removed in the bolt—and mixing the graded flours for the market. The chops and middlings—which really consist principally of endosperm—contain less fibre, ash, oil, and albumenoids than the whole wheat; the bran contains much more nitrogen, ash, oil, and fibre than the chops, but not necessarily more gluten; the shorts are poorer in oil, fibre, and ash than the bran; the germ is poor in carbohydrates, but very rich in oil and albumenoids, sometimes giving as much as 15 per cent. and 32 per cent. of the two latter respectively, and contains no gluten. The five classes of middlings, graded by sizes, present a regular decrease in ash, oil, and fibre, from the largest to the lowest, but the albumenoids do not vary much. The patent flour has the greatest number of desirable qualities. 'The results, as a whole, warrant the conclusion that less gluten is wasted in the bye-products than would be imagined,' and appear to show that the hard spring wheats are more suited to the process than the softer winter varieties. The chief fault of the high grade flours obtained by this process is their deficiency in phosphates—a great portion being lost in the bye-products. The full analytical results are carefully tabulated, and the author also refers, for further details, to Bulletin No. 4 of the Bureau of Chemistry, United States Department of Agriculture."

AMERICAN NOTES.

(*From our own Correspondent.*)

New York, September 26th.

The leading iron and steel brokers in this city are in negotiation with iron and steel manufacturers for large quantities of material for winter delivery. An advance is in progress, and large consumers are taking alarm, because of the exhausted condition of their stocks. The wire manufacturers met yesterday and advanced prices 10 to 15 per cent. The wrought pipe manufacturers met in Philadelphia on Wednesday, and, while not advancing prices, gave out strong intimations that such would be the course resorted to in a short time. The effect of this announcement has been to crowd in orders for a large amount of material.

Our advices to-day from Western Pennsylvania are to the effect that new natural gas wells have been struck at a distance of 2000ft., and four miles from Pittsburg, and that 12in. and 16in. pipe will be laid at once to bring gas from these wells to the city. Four-fifths of the manufacturers in Pittsburg are now prepared to use natural gas, and others are preparing to follow their example. A great deal of boring is going on within a radius of 100 miles of Pittsburg, and encouraging indications are afloat in other localities.

The Eastern and Western iron market is firm with an upward tendency, and mill irons, puddle bars, old rails, and selected scrap have all advanced 25c. to 50c. per ton. The only article on the list this week that is not advanced is bar iron; but steel is making such rapid inroads that there is no hope of any improving tendency in prices unless an exceptionally active demand would arise. The steel rail mills of this State are crowded with orders, and prices are held at 28 dols. to 30 dols. Two or three large orders have been placed this week at 28 dols. and 28 dols. 50c., and it is probable that more business will be done at about these figures. Heavy purchases of old rails have been made, and importers are receiving inquiries and offers, and in some cases have cabled for supplies.

The plate mills are quite full of orders, but no important orders have come to the structural iron mills, though there are inquiries coming to hand almost every day. Plate iron is 2 dols. to 2 dols. 10c.; angles, 2c.; beams and channels, 3c.; flange iron, 3½c.; fire-box, 4c.; old iron rails are 17 dols. to 17 dols. 50c.; old steel rails, 15 dols. to 15 dols. 50c.; Bessemer iron, 19 dols. to 20 dols. for imported; 10 per cent. spiegeleisen, 22 dols.; 20 per cent., 26 dols.; standard foundry iron, 16 dols. to 18 dols.; standard forge, 14 dols. to 15 dols. 50c.; domestic slabs for nails, 30 dols. to 32 dols. The Pennsylvania makers expect to erect a mill for the manufacture of steel slabs for nails, and have experimented successfully in that direction. Two or three large iron and steel companies have been organised, one in Western Pennsylvania, one in Ohio, and two or three more of financially weakened concerns have been completed, one in Chicago and one in Troy. There is a generally improving feeling in the iron trade from Boston to St. Louis, and buyers are placing their orders with confidence; but still there is a conservatism displayed which shows that there are still some doubts in the minds of consumers as to the ability of the manufacturers to hold prices at the advance.

The American Banking Association is in session at present at Chicago, and will take measures to arrest the silver coinage, and to place the banking system now in vogue upon a stronger foundation. The revenue reformers are preparing to prosecute some active work this winter, in and out of Congress, and the protectionists have taken the alarm and are preparing to meet them.

The dispute between Vanderbilt and some of his stock holders, with reference to the disposition of the South Pennsylvania Railroad, is still the topic of discussion in railroad circles. Vanderbilt declares he will drop the enterprise, and the Pennsylvania Railroad has resolved to purchase the "holes in the ground." The right to sell this franchise is now under consideration by the State Government. The Reading Railroad Company has taken steps to enforce the complaint of the South Pennsylvania Road. The Pennsylvania Railroad will oppose it, in order that it may be in a better position to oppose the efforts of the Baltimore and Ohio Railroad people in their efforts to establish terminal facilities at New York.

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

(*From our own Correspondent.*)

The quarterly meetings of the iron trade, which came off in Wolverhampton yesterday, and in Birmingham this—Thursday—afternoon, were well attended by traders from the leading iron and steel and tin-plate districts throughout England. Exceptional interest was aroused in the gatherings by the recent appearance of revival in some branches of trade. The meetings were an improvement upon those of a quarter ago, alike as to the prices which prevailed and the expectations of the market concerning the early future.

As has been expected, sheets showed up by far the best. These makers all reported themselves with plenty of orders on their books, and they secured a fair number of additional contracts yesterday and to-day alike from the galvanisers, from the hardware manufacturers, and from export merchants. The prices which they quoted for 24 and 27 gauge were in advance over a quarter ago of between 5s. and 7s. 6d. per ton, namely, £7 2s. 6d. to £7 5s. for 24 gauge, and £8 2s. 6d. to £8 5s. for 27 gauge; £6 15s. to £6 17s. 6d. was the general price for 20 gauge.

Galvanised sheets at the Wolverhampton meeting were active, and makers were very firm in price. Some galvanisers asked an advance of as much as 10s. per ton upon the late minimum rates, although the bulk were content with an advance of 5s. to 7s. 6d.; £11 to £12 5s. was quoted for 24 g. f.o.b. Liverpool. Orders are arriving on account of Australia, New Zealand, South America, India, and South Africa.

The makers of thin sheets and tin-plates were in excellent spirits, and reported an active business on account of Canada, the United States, South America, Australia, Germany, and other parts of the Continent. Home buyers are also expressing their wants freely. Working up sheets were quoted £10 to £11 per ton, and stamping sheets £11 to £12. Thinner gauges advanced by stages of 20s. per ton up to a maximum of about £16.

Tin-plates were quoted by these same South Staffordshire and East Worcestershire makers at an advance of between 6d. and 1s. 6d. per box on three months ago. Common cokes were quoted 15s. to 16s.; best cokes, 16s. to 17s. 6d.; and charcoal plates, 19s. to 20s.

Marked bars were re-declared by Mr. E. Fisher-Smith, the agent of the Earl of Dudley, at £8 2s. 6d., and the other very few marked bar houses, such as William Barrows and Sons, John Bradley and Co., the New British Iron Company, and Noah Hingley and Sons, re-declared £7 10s., a standard which has now existed for nearly three years past. Except as to the two first mentioned firms, it is, however, well-known that the £7 10s. quotation is hardly more than nominal, export orders for best bars being freely filled at £7 and £6 15s.

Several of the best bar houses also continue to make what they term a second quality, for which they demand £6 10s. to £6 per ton. None of the best bar houses were able to report much improvement in demand, and about four days a week is their average make. The Australian demand is quieter than a while ago, but South African orders are looking up a little.

Common bar makers are not active, and they quoted £5 10s. down to £5 5s. Hoops and tube and nail strip were without change on recent prices. The all-mine pig makers of Shropshire and Staffordshire re-declared previous quotations, which are nominally 60s. for hot-blast and 80s. for cold-blast qualities. In reality, however, 55s. to 57s. 6d. is about all that is being got for hot blast, and, except in a few instances, 75s. to 77s. 6d. for cold blast. The Lilleshall Iron Company, Shropshire, however, have recently realised half-a-crown advance on some special foundry makes, which brings the price above 80s. per ton. This firm reported some good sales during the past few weeks. The Earl of Dudley's pigs were quoted by Mr. E. Fisher-Smith at 62s. 6d. for forge sorts, and 67s. 6d. for grey qualities. His lordship is now blowing three furnaces.

Hematites at the Wolverhampton meeting were very firm, but without much business. West Coast firms would not quote less than 54s. for No. 4 forge sorts delivered, though here and there sales were said to have occurred at 53s. Some Workington firms demanded 55s. for No. 4 forge, 56s. for No. 2, and 57s. for No. 1, delivered.

Sales of Midland pigs were not large, but prices were pretty firm at an average for Derbyshire sorts of 40s. delivered to works, though some Derbyshire brands were quoted at 41s. Northamptons were an average of 38s. to 39s. Thorncliffe pigs were quoted 50s., without business.

As to Staffordshire second and third-class pigs, the Spring Vale Company reported that their sales in the past three or four weeks had aggregated not far short of 20,000 tons. They quoted hydrates 52s. 6d.; mine, 45s. to 42s. 6d.; and common, 35s. Willingsworth pigs were 38s. Other second-class pigs were 37s. 6d. up to 40s., and common cinder pigs 32s. 6d. to 35s. for forge sorts.

The Birmingham and District Railway and Canal Rates' Association resolved on Tuesday to send a deputation to Mr. Chamberlain, who would be asked to give an expression of opinion concerning the best course to pursue to get the question of railway rates before the next Parliament. It was also determined to get the question brought prominently to the notice of candidates at the ensuing election as a commercial matter deserving careful consideration.

Furnace and forge coal is in rather better sale this week, and the Earl of Dudley's prices are:—Furnace, 9s. 6d. and forge 8s. 6d. Ordinary collieries quote furnace coal, 8s. to 8s. 6d.; mill coal, 6s. 6d. to 7s. 6d.; and forge coal, 5s. 6d. to 6s. 6d. Cannock Chase coal prices are giving up, and an early official advance is anticipated in house sorts.

In accordance with resolutions passed at the Nottingham National Conference of Miners, the colliers in some of the South Staffordshire localities have resolved this week to ask the employers for an advance of 15 per cent. on the present wages. The answer of the employers is to be communicated to the conference which is to be held at Manchester.

The tin-plate workers are receiving inquiries from the War-office for certain goods needed for store.

The horse-nail makers at Old Hill have this week determined to give notice for an advance of 3d. in the 1000—the notice to expire on the 17th inst. It was stated that the men at the present time were in a state of semi-starvation.

A meeting of the members of the South Staffordshire Institute of Mining Engineers was held at Dudley on Monday. Mr. Durham, the inventor of the compensating oil rings, read a paper on the articles, showing them to be clean, economical, simple, and effective—qualities which the old system of packing piston-rods did not possess. The members discussed the paper, and all were of opinion that the invention was a valuable one, and would effect a saving not only in oil, but in the rods themselves. A discussion also took place on the merits of the Capell fan in the ventilation of mines, and the Rev. G. M. Capell was thanked for having introduced the subject to the institute.

The quarterly meeting of the North Staffordshire Coal and Iron Masters' Association, was held at Stoke-on-Trent on Monday. It was reported that the sudden increase in the demand for iron which occurred a month or five weeks ago had not been maintained. Prices for pig and finished iron, as likewise for ironstone were reported to be as low as they had been at any time during the year.

At Birmingham to-day Wolverhampton prices were fully confirmed; business in all but sheets was quiet. A most important announcement was made. It was that Messrs. Nettlefold have determined to transfer the whole of their iron, steel, and wire rod business as now carried on at their Castle Ironworks, Wellington, to South Wales. An extensive sight has been purchased some five miles from Newport, where new works will be erected. The Castle Works will be closed, and will be offered for sale. The reason for this action is the excessive railway rates charged for conveyance of manufactured goods and raw materials to and from the coast. The Castle Works were erected some ten years ago at a cost of £60,000 to £80,000, and £40,000 has also been expended on collieries. This removal is the most important which has occurred since the action of Messrs. Cammell.

A local economical invention, which has been adopted at several ironworks in this district, is, I learn, just now making a start among the ironmasters of Pittsburgh, Pennsylvania. It is the patent hot-air chamber of Mr. Job. Tibbs, for the utilising of the dry oxide cinder bottoms in mill and other heating furnaces. By means of this invention the obnoxious sand bottoms may be wholly abolished from ironworks, and a superior quality of iron produced at a cost of from 5s. to 7s. 6d. per ton less, and in some cases the saving is, it is stated, as much as 10s. per ton. The chamber is in successful operation at the Great Bridge Iron and Steel Works—where four chambers are in operation; at Messrs. Firmstone's, Crookhay Works; Messrs Wilkinsons works, Dudley Port; Messrs. Lones, Vernon, and Holden, at Smethwick; the Hyde Ironworks, Stourbridge; and Messrs. Russell's Cyclops Works, Walsall. The chamber is also in use in Scotland and in some other districts.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—A generally dull tone has continued throughout the iron market here during the past week, and in pig iron especially there has been an absence of buying, which is now being followed by a downward tendency in prices. Generally makers still hold to late rates in their quoted prices, but buyers who have orders to give out are able to place them on more favourable terms than they could a week or two back, in some instances to the extent of fully 6d. per ton. In manufactured iron the attempted advance in prices has never really been established, except in the case of sheets, but a firm tone is being maintained on the basis of the old rates. Generally it may be said that although the recent upward movement in the market has now apparently collapsed, it has left makers in a stronger position to the extent that they are better supplied with work than they were, and the very low cutting in prices which was previously prevalent to secure orders has, for the present at least, been effectually checked.

The iron market at Manchester on Tuesday was tolerably well attended, but there was again only a very small weight of business doing. For Lancashire pig iron, and also for good district brands, the average quoted prices for delivery equal to Manchester remained at about 39s. to 39s. 6d., less 2½, but in some instances there was a disposition to entertain offers at 6d. under these figures, and there were brands of Lincolnshire iron for which the actually quoted list rates had been dropped to 38s. 6d. and 39s., less 2½, delivered here.

Hematite continues in very poor demand, with makers accepting low offers to secure orders, and the average quoted rates for good foundry brands delivered into this district remain at about 52s. 6d., less 2½ per cent.

Manufactured iron makers report that they are being kept fairly well supplied with work, and although there is no actual pressure of orders in the market, they are very firm at £5 5s. for bars delivered into the Manchester district as the minimum basis of prices.

The condition of the engineering trade seems, if anything, to get worse, and there is so little new work coming forward that in most branches the prospects for the future are very discouraging. Some of the tool makers who are engaged in specialities are fairly busy, but in the general run of tools there is very little doing. The principal boiler makers are fairly off for work, and the same may be said of some of the leading machinists. Generally, however, where there is any activity, it is in finishing work, and it is very exceptional where new orders of any weight are being got. Locomotive builders are moderately employed, but it is the same in this branch as in others—there is extremely little new work being got, and the competition for any work giving out is excessively keen, whilst the large heavy engineering works as a rule are already very slack.

Other branches of industry dependent upon engineering, such as brassfounders, coppersmiths, nut and bolt makers and ironfounders, are also all extremely quiet, and amongst the nut and bolt makers the competition for orders is so keen that any attempt at adhering to the Association list rates has practically been abandoned.

The chief public event in Manchester during the past week has been a demonstration, extending over several days, to celebrate the passing of the Manchester Ship Canal Bill. The processions of trade and other societies, the public meetings, and the banquets, have certainly evoked an amount of enthusiasm in the project, which, if this were all that were needed, would at once be a guarantee of the success of the scheme, and it must be very gratifying to the promotors that they are backed up in the work they have undertaken byso strong a public feeling throughout the district.

Notwithstanding the vigour with which the promoters of the Manchester Ship Canal are pushing forward their project, the Bridgewater Navigation Company, whose undertaking will have to be absorbed in the greater scheme, is still proceeding with several important improvements of their waterway, which were commenced prior to the Ship Canal Bill being passed. Two large new weirs are being constructed, one of these at Modewheel, in the outskirts of Salford, being nearly completed, and the second being in course of construction at Warrington, where the river meets the tide. Both of these weirs are on the tilting principle, and on precisely the same lines as the Throstle Nest Weir, which has given such good results. The new weir at Modewheel will be 120ft. wide, that at Warrington 140ft. wide, and the effect of these weirs, which will replace fixed weirs with a few small sluices, will be to very much increase the discharging power of the river.

By far the largest economiser that has ever been put into a single chimney has just been shipped by Messrs. Arthur Lowcock, engineers, of Shrewsbury, to the Merrimac Manufacturing Company, Lowell, Mass. This economiser, when erected, will contain no less than 3072 pipes 10ft. 2in. in length, with an internal diameter of 4in., and the total weight of the pipes is about 400 tons. These pipes will be erected in two stacks, but both going into one chimney, and the economiser is constructed on improved designs recently introduced by Mr. Arthur Lowcock, of Shrewsbury, and Mr. Thomas Sykes, of Manchester, for efficiently cleaning out any deposited sediment from the pipes. This is effected by a very simple arrangement, the bottom boxes of the economiser being the only parts that are altered. The bottom sides of these are inclined downwards from the feeding inlet, and at the other end a hole with a flange is made in the casting. These boxes are bolted to a pipe, which is closed at one end and has a blow-off tap at the other. If the feeding inlet is at one end of the economiser the blow-off cock is placed at the other end, and the current of water is made to force any mud that deposits in the bottom boxes, so that in blowing off the latter is certainly removed.

An ingenious and very simple revolving sight lubricator has been invented and patented by Mr. R. Lauder, of Manchester. The apparatus consists of an iron disc cast in two halves which is screwed on to the shaft; this disc revolves in a cistern of oil carried underneath the shaft, and at each revolution takes up a small quantity of the lubricant, which is gathered off the disc by a scraper and passed on by a small channel to the journals. The supply of lubricant can be regulated as required, and the feed by the revolving disc is, of course, in exact proportion to the speed at which the shaft is revolving, whilst the oil droppings from the journals being caught in the cistern, none of the lubricant is wasted. This lubricator can be applied to any bearing where there is room to get a disc put on the shaft, one essential in this respect being that the disc must be large enough to carry the oil about an inch higher than the mouth of the oil hole in order to give it a fall from the scraper to the journal. The cisterns for the oil can be made of tin, brass, or cast iron, and are constructed to suit any pedestal or hanger where there is sufficient space for the apparatus. The whole of the parts are so devoid of any complication that there is practically nothing to get out of order, and from an inspection I made of one of these lubricators it certainly did its work very efficiently.

In the coal trade a fairly good demand is being kept up for the better qualities of round coal for house fire purposes, and although the full extent of the advance in prices at the commencement of the month is not being maintained generally, about 6d. per ton above September rates is being got without difficulty. Other descriptions of fuel continue very depressed; common round coal is still very bad to sell for ironmaking and steam purposes, and the continued stoppage of the cotton mills in Lancashire causes slack to be quite a drug in the market. At the pit mouth best coal averages 9s.; seconds, 7s. 6d.; common house coal, 6s. 6d.; steam and forge coal, 5s. 6d.; burgy, 4s. 6d. to 4s. 9d.; best slack, 3s. 6d. to 4s.; with ordinary sorts to be got at any price from 2s. 6d. per ton upwards.

Shipping has been fairly good with, in some instances, a slight advance in prices being got; but steam coal is still to be bought readily delivered either at the Garston Docks or the high level, Liverpool, at about 7s. per ton.

The miners' agitation for an advance of 15 per cent. in wages is meeting with no success; the Ashton and Oldham Coalowners' Association, at a special meeting held in Manchester on Tuesday, declined to entertain the request, and in the South-West Lancashire districts the coalowners are individually giving similar replies to the deputations from the men that wait upon them.

The annual meeting of the Manchester Geological Society was held on Tuesday, Mr. Joseph Dickinson, her Majesty's Chief Inspector of Mines, in the chair. A very satisfactory report, both as to membership and finances, was presented, and Mr. H. M. Ormerod, F.G.S., was elected president for the ensuing year.

Barrow.—There is still a firm tone in the hematite pig iron trade of this district, and the probabilities are in favour of a continuance of this state of things, although there is no hope of any improvement during the ensuing winter which will materially increase the weight of sales of pig iron. The fact is that on home account the business doing is slight, while on foreign and colonial account the inquiry is the opposite of being spirited. The output is not quite up to half of what it could be made if makers had the trade to do, and it is noteworthy that both the general consumption of pig iron and the demand on the part of steel makers who are using very light weights of metal for purposes of conversion into steel, are confined within limits which demonstrate at once the absence of any life on the part of those doing trade in Bessemer and hematite qualities of pig iron. The value of pig iron is fairly maintained at 42s. 6d. per ton net at makers' works for mixed samples of Bessemer iron, and 41s. 6d. for No. 3 forge and foundry samples, prompt delivery. The quotations for forward sales are 1s. per ton higher than these rates. It is somewhat remarkable that for some four or five months past these prices have practically ruled the market—a proof that while, on the one hand, makers have found it impossible to sell their iron at fuller prices, they have, on the other, resisted any attempt at downward prices, which a paucity in demand ought to be expected to cause. The fact is that the lowest point was reached, and except in exceptional cases sales were not made at less money than is here quoted. Shipbuilders are wanting orders. Engineers are rather busier. Iron ore in quiet demand. Coal and coke in lessened consumption. Shipping not so well employed as of late.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

Thus writes a gentleman in an excellent position for knowing, in a letter received by me yesterday:—"The talked-of improvement is all moonshine as far as the heavy Sheffield trade is concerned." I am afraid this about sums up the situation. Even in armour-plates only one of the large establishments—Messrs. John Brown and Co.—is busy on the orders for the cruisers let some time since. This firm will be well occupied for at least six months, when the orders for the armour of the big armour-clads should be ready to be given out. In iron there is really no advance in values in this district, and steel keeps as languid as ever, the leading house engaged exclusively in steel having its shares at present excessively weak.

Our Indian railways are about the only sources of work at present. What are being ordered are principally locomotives, for which Glasgow is the fortunate city. A good deal of the work for them, however, comes to Sheffield manufacturers. The North British Railway is buying 500 sets of wheels and axles. Tire and axle makers hereabouts hope to secure the tires and axles for them.

In the lighter industries trade keeps as last noticed. Fine razors are again in request, and full employment is given; but there is little doing in secondary and inferior qualities. This is a remark applicable to nearly all descriptions of hardware and cutlery, the commoner "lines" being largely taken by French, German, and American competitors.

The Yorkshire Miners' Association, acting through their Council, have promptly followed up the resolutions passed at Nottingham. A meeting was held at the head-quarters at Barnsley, on Monday, at which the secretary, Mr. Benjamin Pickard, was instructed to write to the coalowners of Yorkshire, asking them to concede 15 per cent. advance on the present rate of wages, and to meet a deputation to discuss the matter, as well as the question of a scheme to regulate remuneration in the future, a deputation of fifteen miners, along with the officials, were appointed to meet the owners on this question. A further conference is to be held at Barnsley next Wednesday to hear the report of replies of the coalowners, and to take into consideration points commended at the Nottingham Conference, which referred to the day upon which the notices of ceasing labour shall be given, and to take steps to enforce the resolution for an advance in the different districts. Another important matter decided upon at the Nottingham Conference had reference to the necessity to adopt some stringent plan of restriction of a uniform character which the miners' delegates believe to be indispensable to any permanent improvement in prices and wages in the coal trade.

In Derbyshire the miners have also been holding meetings at which the business was divided between supporting Mr. James Haslam, the labour candidate for the Chesterfield division, and agitating for an increase in wages. The candidate laid down as an axiom that the miners could have better wages if they liked, and if the working classes wanted to govern the country they could do so now that the power was put into their hands. The assistant secretary of the Derbyshire miners held that it was trade unionism that got the advance of wages in 1882, and it was owing to there being so many non-unionists that the advance was taken from them again. The miners must act hand-in-hand in this movement to be successful. When they got an advance they got it on the humanitarian principle, but he held that from that point of view they expected not 15 but 50 per cent. Over-production had increased so much that Derbyshire could be done without in meeting the demand for coal. If necessary coalowners and colliers should do away with middlemen. He went the length of suggesting that the colliers should fix the price of coal, and said that even if the pits were laid idle that course would compel masters to give the advance.

The closing of the Milton and Elsecar Ironworks has attracted the attention of the Leasehold Enfranchisement Association—a semi-political body recently formed in Sheffield. This Association sent an agent to Milton and Elsecar to obtain information on the subject. He has communicated the result of his inquiries, which are to the effect that the works were in active operation as far back as 1806, and that some thirty-six years ago they were taken in hand by Mr. George Dawes, who held them in lease from the ground-landlord, Earl Fitzwilliam, to the close of 1884, when the lease expired. The agent further states that, previous to the expiration of the lease, several applications were made by the lessee for its renewal, failing which the works might be taken over as a going concern, at a valuation of £50,000. The negotiations, however, fell through, and it is asserted that this was probably due to an unfortunate dispute which took place between the parties some time ago relative to certain mineral contracts. The loss in wages by the stoppage of these works is said to be £1000 per week. Milton and Elsecar are not the only ironworks which are closed, or at least doing nothing—which is practically the same thing—in these parts. At Swinton, Attercliffe, Sheffield, Wortley, and other places, large establishments, formerly devoted to iron productions, now stand motionless.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE quarterly meeting of the Cleveland iron trade was held at Middlesbrough on Tuesday last. The attendance was good, but visitors from other districts were scarce. Business was exceedingly quiet; few sales were made, and prices were somewhat lower than on the previous Tuesday. The usual quotation among merchants for No. 3 g.m.b. was 32s. 4½d. per ton for prompt delivery, and the little business which was done was at that figure. Makers as a rule would not accept less than 33s. per ton for No. 3, and as many of them are well supplied with orders for the present, they frequently decline to quote either for prompt or deferred delivery. There is but little inquiry for forge iron, and the price remains unaltered at 31s. 6d. per ton.

Warrants are not so firmly held as they were. The price usually asked is 33s. 3d. per ton for No. 3, but some sellers have accepted 33s.

The deliveries of pig iron into Messrs. Connal and Co.'s Middlesbrough store have diminished considerably of late. Only 2535 tons were sent in last week. The stock now amounts to 101,698 tons, which is more than double what it was at the beginning of June.

Orders for finished iron are very scarce, and specifications against existing contracts are difficult to obtain. Few mills are working full time. Quoted prices are as follows:—Ship-plates £4 15s. per ton; angles, £4 10s.; and common bars, £4 17s. 6d.—all free on trucks at manufacturers' works, less 2½ per cent. discount. Slight reductions on the above prices are made by most firms for favourable specifications.

The North-Eastern Railway Company has issued orders for 20,000 tons of steel rails. This quantity has been nearly equally divided between Messrs. Bolckow, Vaughan, and Co., the North-Eastern Steel Company, the Darlington Steel and Iron Company, and Messrs. Steel, Tozer, and Co., of Sheffield.

The annual general meeting of Messrs. Armstrong, Mitchell, and Co., was held at Newcastle on the 29th ult., Sir W. G. Armstrong occupying the chair. The report set forth that after deducting £79,154 for depreciation, the profit on the year's working was £160,692. A dividend of 8 per cent., was declared. Referring to the recent strike, the chairman stated that the loss of wages to the men for the fifteen idle days amounted to about £20,000; besides which a contract had been taken out of their hands by a foreign competitor, the wages for which would have been about £30,000.

The Ironmasters' returns for September were issued on the 3rd inst. They show that the total make of all kinds of pig iron during the month was 202,152 tons, being a decrease of 4506 tons when compared with August. The total stocks in the whole district were 422,429 tons, being a decrease of 781 tons. This is the first decrease in stocks for many months. Makers' stocks were reduced by 29,102 tons, but Connal and Co's stock increased 23,518 tons. Shipments of pig iron were better than for any month since last October, being 85,198 tons. Scotland, the best customer, took 37,728 tons; Germany 17,705 tons, Holland 5420 tons, Wales 4928 tons, France 4490 tons, and Norway and Sweden 3339 tons.

A very interesting experiment connected with the generation of steam is at present being conducted by Messrs. Saddler and Co., manufacturing chemists, Middlesbrough. Messrs. Saddler and Co. buy enormous quantities of coal-tar, from which they extract certain ingredients, which they utilise for making Turkey red and other dyes. These ingredients, however, do not amount, at the very most, to more than 10 per cent. of the crude material. Another 40 per cent. is sold as pitch for export to certain foreign countries, where it is mixed with small coal, and formed into briquettes for fuel. The remaining 50 per cent. exists in the form of a dark-coloured mineral oil, excellent for combustion, but useful for no other purpose. Being short of steam power, Messrs. Saddler determined to use this tar residuum instead of coal for raising steam, believing that thereby they would obtain a higher evaporative effect as well as save coal. The arrangement for burning is similar to that adopted in the locomotive and marine boilers employed in Asia Minor and Caspian Sea, where petroleum is plentiful.

A valuable paper was read on this subject at the recent Cardiff meeting of the Institution of Mechanical Engineers, and will be found with full illustrations in the "Proceedings" of that body. Messrs. Saddler and Co. have again proved that it is absolutely necessary to line a portion of the flue, or an external continuation thereof, with fire-bricks, in order to form a reservoir of heat, a purpose analogous to that of the fly-wheel of a steam engine. They also prefer to dry or superheat the steam used for injecting, by leading it through a coil passing round the interior of the furnace. The dried steam entering an injector nozzle, directed along the axis of the flue, draws in with it a certain quantity of air and of tar residuum.

The function of the steam appears to be simply to draw in and spread and disintegrate the particles of liquid fuel and of air, so as to enable combustion to take place the moment the heated brickwork is reached. If the steam is decomposed, which is doubtful, the heat gained by the subsequent combustion of the hydrogen could only equal that absorbed during decomposition. There can, therefore, be no gain, but it may afford a convenient method of taking up heat at a point where it is excessive and restoring it further on where it can be better utilised by the heating surface. Messrs. Saddler consider that one ton of liquid fuel is equal in evaporative power to 2¼ tons of good unscreened coal. The value of the former at the works is £1 per ton, and of the latter 7s. per ton. The labour of stoking is, however, saved in the former case, and the rate of evaporation is increased by one-fourth. With the above relative values coal is obviously the cheaper, but where coal is 10s. per ton or above and liquid fuel remains at 20s., then the latter would have the advantage.

The Tees Union Company, whose steamers ply between the Tees and London, has decided to fit up a boiler with appliances for using liquid fuel, and believe that the case is one in which great advantage will accrue. For sea-going steamers plying to distant ports the difficulty will be to obtain fresh supplies of fuel of this particular kind at any except certain specified ports, where stocks may be arranged to be kept.

The furnace fires at Messrs. Saddler and Co.'s look well. A good, full, bright flame seems to pervade the flue, and extend inwards as far as the eye can reach. By turning the proper stop cocks, the combustion can be regulated at will, according to the pressure of steam shown by the gauge. Altogether, the experiment is interesting and suggestive, and the system under favourable conditions is likely to prove very successful.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Scotch pig iron trade is in a comparatively favourable position. Shipments are better than they have been for a considerable time. In the past week they amounted to 11,297 tons, as compared with 11,022 in the preceding week, and 9655 in the corresponding week of 1884. The demand for the better quality of Scotch pig on the part of Canada is greater than it was at this time last year, and an increased amount of pig iron is also going to Australia. In the meantime the wants of Russia appear to be pretty well met, and the requirements of most other countries are below the average. There are ninety furnaces in blast, against ninety-two at this date last year. The last week's addition to the stocks in Messrs. Connal and Co.'s Glasgow stores was about 1100 tons, being considerably less than has been usual of late.

Business was done in the warrant market on Friday at 42s. 6d. cash. A large number of transactions took place an Monday at 42s. 5d. to 42s. 8½d., closing at 42s. 7d. On Tuesday forenoon the quotations were 42s. 7d., 42s. 8½d., and 42s. 7½d. cash, and in the afternoon 42s. and 42s. 7d. cash. On Wednesday forenoon transactions occurred at 42s. 7d. to 42s. 6d. cash, whilst in the afternoon there was a further decline to 42s. 4½d. cash, closing with sellers at 42s. 5½d. cash, and buyers a halfpenny per ton less. To-day—Thursday—being a holiday in Glasgow, no market took place.

The current values of makers' iron are:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 46s.; No. 3, 44s.; Coltness, 49s. 5d. and 46s.; Langloan, 48s. and 45s. 6d.; Summerlee, 48s. and 44s.; Calder, 52s. and 44s.; Carnbroe, 45s. 6d. and 43s.; Clyde, 46s. and 42s.; Monkland, 43s. and 40s. 6d.; Quarter, 43s. and 40s. 6d.; Govan, at Broomielaw, 43s. and 40s. 6d.; Shotts, at Leith, 47s. and 46s. 6d.; Carron, at Grangemouth, 51s. and 47s.; Kinneil, at Bo'ness, 44s. 6d. and 43s. 6d.; Glengarnock, at Ardrossan, 46s. and 42s. 6d.; Eglinton, 42s. 6d. and 39s. 6d.; Dalmellington, 43s. 6d. and 40s. 6d.

Some interest has been shown on 'Change in Glasgow in a report that 700 tons of pig iron, said to be the first instalment of a large quantity, has been landed in the Mersey from America. Scotch merchants do not see how this business can possibly pay. But even if it should, they say they are prepared to supply their customers with iron that can be used at a profit, no matter from whence it comes. It is but right to add, however, that the matter is regarded by the ironmasters from a very different standpoint.

A contract to supply 70 tons of cast iron for girder bridges, required by the Glasgow and South-Western Railway Company, which was expected to fall to Scotch makers, has been given to Messrs. Robertson and Co., of Workington.

From one or two of the Clyde shipyards considerable numbers of workmen were discharged on Saturday, owing to lack of employment. It is gratifying to notice, on the other hand, that Messrs. John Elder and Co., of Glasgow, have secured an order to construct three large paddle steamers of about 1700 tons each, for the Zeeland Company of the Netherlands, to ply between Queensborough and Flushing. It is stated that the steel for these vessels will be furnished by Messrs. I. and W. Beardmore, of Parkhead, and by the Steel Company of Scotland. The Messrs. Elder have now seven steamers on hand, and they will be able to give work to a number of the unemployed.

The past week's shipments of iron and steel manufactures from the Clyde embraced six locomotives, valued at £16,500, for Kurrachee; a steam barge, £930, for Perim; £6500 of machinery for different places; £4500 sewing machines, £9780 steel goods, and £41,000 general iron manufactures, of which £10,880 represented bridge work for Calcutta, and £6000 pipes for Melbourne.

The coal trade is fairly active; but as yet the prices have not marked any improvement. The shipments of the past week have embraced 27,225 tons from Glasgow, 3182 from Greenock, 13,729 from Grangemouth, 6429 from Ayr, 7493 from Troon, 2174 from Irvine, and 2523 from Leith. The returns of the shipments of coals from Burntisland in the course of September give a total of 77,000 tons, being an increase of 6000 on the same month last year. During the nine months the quantity despatched has been 722,390 tons, or 1435 tons more than in the same period of last year. Coalmasters report that some improvement is now perceptible in the demand for steam coals, which had been in a backward state for a succession of weeks. There is also more inquiry on the part of the domestic consumer.

The resolution of the coalmasters at a meeting held last week to make common cause with Messrs. William Barr and Sons, of Allanton, Langlea, and Dalserf collieries, in the dispute with their men, promises to terminate the quarrel for the present at least. The men stopped work in all these collieries because the employers refused to dismiss six of their number who failed to observe the Thursday weekly holiday. The Messrs. Barr were also informed that no one would be allowed to return to their employment until he agreed to a five-days' week, an eight-hours' day, and an advance of 6d. a day on present wages. The other coalmasters, considering that if the men were successful in this case, they would likely gradually adopt the same policy in all other instances, resolved that they would employ no new hands until the men returned to Messrs. Barr's pits. The effect of this resolution is that the miners were unable to obtain work elsewhere, even if they resorted to the common practice of giving *aliases* instead of their correct names. The consequence was that in a few days the colliers returned to their work at Langlea and Dalserf.

During the month of September 132 vessels with an aggregate tonnage of 116,463 arrived in the Clyde, against 126 vessels of 96,252 in the same month last year. The month's sailings were 159 with 148,931 tons, against 180 of 156,777 tons in September, 1884.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE meeting of tin-plate makers at Swansea on Saturday last has given new confidence to the trade, and I am glad to chronicle a firmness in quotations, and a hopefulness as regards the future which augurs well.

The report I gave currency to last week, that one maker had left the combination, is, though fully reported and believed at the time, now stated on the best authority to be incorrect. Mr. Spence, the president of the trade, stated at the meeting that the combination was intact. The tin-plate works now in operation in Gloucestershire and South Wales number 79, and consist of 367 mills. The combination is formed of 75 works and 354 mills, so that outside the union of masters only 4 works, consisting of 13 mills, can be found.

The result of the experimental stop-week was regarded as so satisfactory that it was decided by the meeting to continue the agreement, which was to end with the present year, and from the 31st of December to the 30th of June next, have one stop week in every six weeks.

The meeting was pleasantly concluded by a proposition from Mr. Rogers that a contribution of £2 per mill should be made to Mr. Spence "as an appreciation of his efforts to bring about unity of action, and in rallying the trade from the depression into which it had fallen."

Quotations are firm for ordinary cokes at 14s. 3d. to 14s. 9d.

One of the tin-plate works of the district is announced as having failed, and a committee of management for the benefit of creditors is reported. I expect this is a prelude to others, for the more stringent the unity the greater the difficulty of small works to weather the storm.

After the despatch of my last week's letter I was made aware of movements in the iron trade of the district which pointed ominously to a reduction of wages, and on Saturday this was announced at the principal works. Such is the dearth of orders that I am afraid unless a decided turn take place that a reduction will be enforced from the 1st of November. The notice put up at the works is to the effect that all contracts are to cease with this month, and this will affect all employed in connection with the iron and steel works. The colliers who are governed by their own sliding scale will not be affected by this notice.

In the face of the widespread reports of a revival in the iron trade, this has come upon the district with a good deal of surprise. I am afraid that South Wales has not shared much in the improvement which has taken place in bar, wire, and manufactured iron. Steel rails are in slight request here, and steel sleepers do not appear to have overcome yet the prejudices of those who believe in wooden sleepers.

Silver lead mining is coming again to the front in North Wales, or, more precisely, Cardiganshire. I have just visited a wide district, which may be called the graveyard of limited companies in lead mining. Names were associated with these of capitalists in London and the large cities; but in too many cases capital had been expended in vain, and the "gravestones" were represented by silent wheels, fast decaying inclines, mounds of refuse, and deserted shanties. As a rule nature is not doubly generous. You cannot get good yields of corn over the coal measures. So with these northern Welsh hills. In their rugged sublimity they remain the objects of the profoundest interest to the artist and tourist, but the lodes of minerals underneath have rarely been worked to any other benefit than to the promoters of companies. I see that one is announced in the county of Cardigan, called the Talybout Silver Lead Mining Company, and for the district I hope it will prove a success.

The past few months must have told heavily upon many a coal-owner. Last week the sidings near Cardiff were literally "choked," but with the increased export this will soon disappear. Twenty thousand tons more were despatched from Cardiff last week than in the previous week, 7000 tons more from Newport, Mon., and 5000 tons more from Swansea. Rates are better for northern French ports this week, but slightly easier for the Mediterranean. Patent fuel still keeps rather dead, but small steam coal is getting into freer demand. Thirteen thousand tons of foreign ore came into Cardiff last week, and 17,000 tons into Newport.

There is a turn taking place in the steam coal trade. Exports are decidedly improving, and as house coal at this time of the year invariably shows an improvement, it is likely that house coal as well as steam will move from its long stagnation.

House coal quotations are looking upward. Last quotations are 8s. 3d. for No. 2 and 8s. 9d. for No. 3.

Messrs. Beith are expecting hourly to strike upon the 6ft. seam at Ynysybwl. The coal was in the 4ft., and of first-rate character.

The Dean Forest miners have ceased their agitation for an advance.

I am afraid the prospects of a further reduction in the South Wales Colliery district is a certainty. The slight revival is almost too late to affect the return.

LAUNCHES AND TRIAL TRIPS.

ON Saturday, the 26th ult., the steamship Torpedo, built and engined by Messrs. Earle's Shipbuilding and Engineering Company, of Hull, for Messrs. Thomas Wilson, Sons, and Co., of the same town, was taken on her trial trip. The vessel, which has been built for the coasting and continental trades, is 150ft. long, 25ft. beam, and 13ft. depth of hold, is classed A1* Liverpool, and has water-ballast forward and aft for trimming purposes. The engines are Earle's three-crank triple compound, having cylinders 14½in., 22in., and 36in., by 24in., and worked most satisfactorily during the run, developing 390-horse power, and driving the ship at a speed of eleven knots. Hodgkinson's mechanical stoker is fitted to the boiler, and worked very effectively.

ON Wednesday, the 30th ult., the steam tug Alexandra, built by Messrs. Earle's Shipbuilding and Engineering Company, of Hull, for the Hull and Barnsley Railway Company, was taken on her trial trip. She is 72ft. by 16ft. 6in. by 8ft. 6in., and is fitted by the builders with their three-crank triple-compound engines, having cylinders, 11½in., 17in., and 30in., by 21in. stroke. These latter gave entire satisfaction, and worked most smoothly and efficiently. The vessel is fitted with a steam fire-engine of good size and power, and is intended for service in the Alexandra Dock at Hull.

NEW COMPANIES.

The following companies have just been registered:—

Browning and Co., Limited.

This is the conversion to a company of the business of machinist and engineer, carried on by Mr. George Browning, at 104, Dale-street, Tradeston, Glasgow. It was registered on the 26th ult. with a capital of £50,000, divided into 1000 preference and 4000 deferred shares of £10 each. The purchase includes patent rights for sewing machines, machinery for forming and working buttonholes, and for kilting, plaiting, or pleating; and also patents for variable crank motion. The consideration is £16,100, payable £100 in cash, 200 preference shares credited with £5 as paid upon each, and 1500 fully-paid deferred shares. The vendor is appointed manager for ten years at a salary of £250 per annum for the first three years, and afterwards at such salary as may be agreed upon between the company and himself, but in default of such agreement, if the company at any time during the remainder of the term shall have paid an average 15 per cent. dividend from the time of the formation of the company, then the vendor's salary for the remainder of the ten years is to be £500 per annum. The subscribers are:—

	Shares.
*George Browning, 104, Dale-street, Glasgow, engineer	1
W. F. Maydwell, Hinsdale, Illinois, U.S.A., commission merchant	1
Henry Johnson, Appleton-in-Widnes, mechanical engineer	1
J. Mook, Rillington, York	1
*T. Robinson, Farnworth, Widnes, ironfounder	1
*B. Brown, Appleton-in-Widnes, ironfounder	1
J. Wilson, 4, Cook-street, Liverpool, iron merchant	1

The number of directors is not to be less than three nor more than five; qualification, 40 shares; the first are the subscribers denoted by an asterisk.

Broadfield Cotton Spinning Company, Limited.

On the 25th ult. this company was registered with a capital of £10,000, in £10 shares, to acquire the estate and interest of Mr. William Joshua Jones in the Broadfield Mill, Broadfield, Haywood, Lancaster, and the goodwill of the cotton spinning business now carried on therein. The subscribers are:—

	Shares.
*A. J. Morris, Chorlton-cum-Hardy, merchant	1
*J. E. Jones, Woodend, Middleton, yarn agent	1
*E. R. Mellor, Sharples, near Bolton, oil manufacturer	1
J. W. Marshington, Chorlton-cum-Hardy, grey cloth agent	1
H. Davies, Old Trafford, merchant	1
W. J. Jones-Heywood, cotton spinner	1
D. E. Griffiths, 13, Clegg-street, Oldham, solicitor	1

The first three subscribers are appointed directors; the company in general meeting will determine remuneration.

Cardiff Steam Coal Collieries Company, Limited.

This company proposes to carry on business as colliery proprietors, coke, and patent fuel manufacturers and miners. An agreement is to be entered into for the payment to Mr. Wm. Galloway, of Cardiff, mining engineer, of the sum of £1000, in fully-paid shares, for services rendered by him prior to and up to the time of registration. The company was registered on the 30th ult. with a capital of £15,000, in £100 shares. The subscribers are:—

	Shares.
*W. T. Lewis, C.E., Aberdare	10
*J. Davies, Cardiff, shipbroker	10
*C. Lundie, C.E., Cardiff	10
A. T. Lucovich, Cardiff, merchant	10
M. Krieger, Cardiff, German Consul	5
*Robt. Day, Cardiff, contractor	10
J. P. Ingledew, Cardiff, solicitor	5
*W. A. Coats, Paisley, colliery owner	10
T. Lindsay Galloway, M.E., Cardiff	5
*J. Gunn, Cardiff, shipowner	10
G. C. Bampas, 4, Great Winchester-street, solicitor	5
J. Boyle, Bournemouth, barrister	5
W. Cubitt, New House, near Cardiff, engineer	5
W. Russell Beith, Pontypridd, mechanical engineer	5

The number of directors is not to be less than three nor more than seven; qualification, shares or stock of the nominal value of £500; the first are the subscribers denoted by an asterisk; the company in general meeting will determine remuneration.

Fac-simile Engraving Company, Limited.

This company was registered on the 30th ult. with a capital of £20,000, in £1 shares, to purchase and extend the business of photo-lithography and photo-zincography, carried on by Mr. Eustace Russell Davis, at 61, 62, and 63, Cowcross-street, E.C., and for such purpose to adopt an agreement of the 9th ult. (unregistered) between Mr. E. R. Davis, and Mr. George Allbeury on behalf of the company. The subscribers are:—

	Shares.
Robert Biggenden, East Peckham, Kent, farmer	1
R. Alliston, 422, Strand, hair merchant	1
E. Wood, Church-road, Homerton, clerk	1
A. Hart, 6, Bow-street, deputy registrar of marriages	1
J. A. Goodenough, 38, Coleman-road, Camberwell, professor of elocution	1
F. A. Polgeran, 85, Kennington-road, glass manufacturer's agent	1
E. Allbeury, George-lane, Lewisham, lithographer	1

Registered without special articles.

Inventors' Syndicate Company, Limited.

This company proposes to acquire, work, and develope British and Foreign patented and other inventions, and to act as patent agents, patentees, and inventors. It was registered on the 25th ult. with a capital of £50,000, in £5 shares, with the following as first subscribers:—

	Shares.
A. Marsden, 167, Kennington-road, secretary	1
E. Crawley, 135, Southampton-road, Reading	1
A. Purcell, Walton-on-Thames	1
C. Landon, Weybridge, warehouseman	1
G. E. Alder, 122, Liverpool-road, N., clerk	1
D. G. Deacon, 3, Highfield-terrace, Lordship-lane, S.E., accountant	1
A. H. Manson, 17, Walling-street, agent	1

Registered without special articles.

Puerto Cabello and Valencia Railway Company, Limited.

This company proposes to acquire a concession, dated 24th February, 1885, granted by the Government of Venezuela to Messrs. Cutbill, Son, and De Lungo, of 37, Old Jewry, for the construction, equipment, and working of a railway from the Port of Puerto Cabello to the City of Valencia. It was registered on the 26th ult. with a capital of £460,000, in £10 shares. The company will carry into effect a contract between the executors of the late Mr. James Perry, of one part, and Messrs. Cutbill, Son, and De Lungo, and John Carruthers of the other part. The subscribers are:—

	Shares.
Arthur Bliss, 43, New Broad-street, secretary	1
J. H Chapman, 64, Wellington-road, Woolwich, shorthand-writer	1
E. T. Botwright, 22, Mehetabel-road, Hackney, accountant	1
F. T. Cutbill, C.E., Albemarle-road, Beckenham	1
F. J. Perry, C.E., 9, Clifton-place, Sussex-square	1
A. Saunders Hughes, Winn-road, Lee, secretary	1
B. Randall Stevens, Worcester Lodge, Putney, accountant	1

The number of directors is not to be less than three nor more than seven; the first are Messrs. T. Collet Sandars, Wm. Newbolt, Nathaniel Geach Burch, and John Rudolph Leseur; qualification, 50 shares; remuneration: chairman (Mr. T. C. Sandars), £500 per annum; each director, £250 per annum.

West African Telegraph Company, Limited.

This company was registered on the 29th ult. with a capital of £1,000,000, in £10 shares, to carry on the business of telegraphy in all branches and in all parts of the world, power being taken to use all known systems or any system which may hereafter be discovered; and to purchase or cause to be manufactured, wires and cables of all kinds for telegraphs, telephones, or other purposes. The subscribers are:—

	Shares.
Abraham Scott, 157, Leadenhall-street, merchant	50
John Miles, 32, Paternoster-row, publisher	100
G. Henderson, 7, Mincing-lane, merchant	50
Matthew Gray, Lessness Park, Abbey Wood, Kent, engineer	100
Robert Kay Gray, C.E., 106, Cannon-street	25
Neil Bannatyne, 15, Earl's-court-square, merchant	50
Wm. James Tyler, 106, Cannon-street, secretary to a company	25

The number of directors is not to be less than five nor more than nine; qualification, shares or stock of the nominal value of £500; the subscribers are to appoint the first; remuneration, £2000 per annum, with an additional £500 for every complete 1 per cent. dividend or bonus in excess of 6 per cent. per annum. The company takes power to acquire and carry out Government, municipal, or other concessions, relating to telegraphs or otherwise.

Wilderness Portland Cement Company, Limited.

Upon the terms of an agreement of the 28th August, this company proposes to acquire leases of limestone quarries under certain lands in the parishes of Micheldean and Abbenhall, Gloucester, known as the Wilderness Estate, and to carry on business as cement manufacturers. It was registered on the 28th ult. with a capital of £12,000, in £100 shares. The purchase consideration is £400 cash, and five fully-paid shares. The subscribers are:—

	Shares.
*Major H. D. Dunlop, 6, Driffield-terrace, York	10
*Major De Courcy Daniell, the Mount, York	10
R. B. Dunlop, Gravesend, surgeon	3
C. A. Dunlop, Bath, spinster	1
W. Woolston, Wellingborough	3
P. P. Turner, Weston, Bath, barrister	1
*M. W. Colchester, Weymyss, Westbury-on-Severn	5
G. Whitcombe, Tuffley, Knoll, Gloucester	2

The number of directors is not to be less than three nor more than five; qualification, four shares; the first are the subscribers denoted by an asterisk. The company in general meeting will determine remuneration.

THROWING A BOILER TOGETHER.

In some articles in the *American Mechanical Engineer* "On Boiler-making by a Boiler-maker," the writer says:—"It looks to me as if rivetting by hand was about dead. No more use for rivetters. When a rivetting machine will drive from 1600 to 1800 rivets per day, and a good gang of snapers from 500 to 800, a gang of rivetters, with their poor 200 to 300, stands no chance alongside of the others. I have seen the material for a 15-horse power boiler—stationary—lying on the floor at seven o'clock in the morning, and at half-past three in the afternoon the boiler was loaded on the cars, completed. How is that for boiler-making? I must say there was no dome on the boiler, but there were two wrought iron flanges rivetted on top for safety valve and outlet. Some may think I am drawing the long bow, but it is the truth, and can be easily proved. It took 1½ hours to flange the heads, and in that time the shell plates—two of them—were punched, planed, and rolled, and straight seams on one rivetted up. When the heads were flanged, the tube holes were punched, the heads put in the shell and marked, and the flanges taken out and punched. Then they put in one course and took it to the rivetter and rivetted it in; when that was done the other course was put on and rivetted; lastly, the other head put in place and rivetted. The time taken to rivet was 1½ hours, and one hour to fit and punch the flanges of heads. As soon as the rivetting was done there were two men put on who set the tubes, and two others to caulk. The time taken on this was two hours, and one hour to test and make all tight. To sum up, it took exactly 7¼ hours to build a 15-horse tubular boiler from commencement to finish. This, of course, is only an instance, but it shows what can be done by modern machinery."

Production of Coke in the United States.—There were 4,873,805 short tons of coke made in 1884, worth 7,242,878 dols. at the ovens. This production consumed 7,951,974 short tons of coal. The amount of coke made was 590,916 tons less than in 1883, and the value was 878,729 dols. less.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

29th September, 1885.

11,547. Balance Door Latch, J. W. Radford and A. Litchfield, London.
11,548. Buttons, C. S. Goodwin and N. F. Palmer, London.
11,549. Fireclay Bricks, J. Parker, Glasgow.
11,550. Treating Vegetable Substances, J. Napier and T. G. Young, Glasgow.
11,551. Washing Clothes, M. Kerr, Poulton-le-Fylde.
11,552. Door Knobs, C. Lea, Silverdale.
11,553. Castors, C. Lea, Silverdale.
11,554. Laying Block Paving in Roads, &c., T. Hunter, Cardiff.
11,555. Regulators for Gas Engines, F. L. Cattrall and C. Stout, Liverpool.
11,556. Ignition Arrangements of Gas Motor Engines, C. Brotherhood, Bristol.
11,557. Spring Bedstead Laths, &c., J. Wilkinson, Dudley.
11,558. Gas Motors, J. Gillott, Barnsley.
11,559. Ventilating Houses, &c., J. Caldwell and D. Hunter, Glasgow.
11,560. Fenders, S. B. Sutcliffe, London.
11,561. Caoutchouc, &c., G. Kassner, London.
11,562. Self-adjusting Candle-shade Support, G. Whyte, Elgin.
11,563. Motive Power, J. Murrie, Glasgow.
11,564. Regulating the Motion of Warp Beams, J. Smith, London.
11,565. Spun Puff Pans, F. Melton, London.
11,566. Electrical Push Indicator, N. G. Thompson, London.
11,567. Aerated Waters, &c., J. T. Leighton, London.
11,568. Copper Plates and Electrotypes, A. F. Wenger, London.
11,569. Laying Electrical Conductors, P. M. Justice.—(*H. C. Spalding and P. McMackin, U.S.*)
11,570. Electro-magnets, P. M. Justice.—(*H. C. Spalding, U.S.*)
11,571. Electric Cables, P. M. Justice.—(*H. C. Spalding, U.S.*)
11,572. Electrical Conductors, P. M. Justice.—(*H. C. Spalding, U.S.*)
11,573. Electrical Cables, P. M. Justice.—(*H. C. Spalding, U.S.*)
11,574. Safety Devices for Electric Circuits, P. M. Justice.—(*H. C. Spalding, U.S.*)
11,575. Buoys and Shells for Submarine Mines, &c., G. L. Schultz and D. Campbell, London.
11,576. Inking Apparatus for Printing Presses, P. M. Justice.—(*T. H. Fitnam, U.S.*)
11,577. Continuous Cutters for Drilling, &c., Metals, L. R. Faught, London.
11,578. Car Wheels, L. R. Faught, London.
11,579. Thermometers, P. Ward, London.
11,580. Dental Engines, &c., S. Pitt.—(*A. W. Browne, U.S.*)
11,581. Leading Paper through Calender Rolls, R. Smith, London.
11,582. Copying Presses, E. Behrens, London.
11,583. Cleansing of Fluids, A. J. Boult.—(*W. A. O. Hegeman, U.S.*)
11,584. Gearing Mechanism for Driving Rolls, &c., W. F. Cochrane, London.
11,585. Railroad Crossings, A. J. Boult.—(*A. C. Rumble, C. E. Phinney, and S. A. Baxter, U.S.*)
11,586. Fire Escapes, R. T. and W. H. Edmunds, London.
11,587. Boxes for the Transmission of Eggs, T. Bradford, London.
11,588. Gas Lamps, G. Godde, London.
11,589. Perforated Glass, A. M. Clark.—(*La Société Appert Frères and La Société Geneste Herscher et Compagnie, France.*)
11,590. Extracting Oil from Waste Products, A. T. Hall, London.
11,591. Pilch Saddles, O. G. Mowat, London.
11,592. Safety Hooks, W. J. Ford, London.
11,593. Window Blinds, R. D. Sanders, Glasgow.
11,594. Cigars, A. Whittle, Pendlebury.
11,595. Cigars, A. Whittle, Pendlebury.
11,596. Gongs for use on Bicycles, &c., T. E. Ware, London.
11,597. Wheels, W. H. Beck.—(*P. Gerbaux, France.*)
11,598. Wash Basins, W. R. Lake.—(*H. C. Lowrie, U.S.*)
11,599. Springs for Carriages, W. R. Lake.—(*W. I. Bunker, United States.*)
11,600. Printing Machines, W. R. Lake.—(*C. B. Cottrell, U.S.*)
11,601. Baby Carriages or Perambulators, W. R. Lake.—(*J. F. Colby, U.S.*)
11,602. Advertising by Night over Large Areas, E. C. Bruce, Oxford.
11,603. Preserve Tins, J. J. Burton, London.
11,604. Stoppering Bottles, O. Imray.—(*W. Painter and L. R. Keizer, U.S.*)
11,605. Metallic Sleeper for Railways, F. W. Rafarel, London.
11,606. Applying Preparations for the Hair, G. W. Simmons, London.
11,607. Water-waste Preventers, E. Knight, London.
11,608. Telegraphic Call Instruments, A. K. Phillips and A. W. Granville.—(*F. Gridley, U.S.*)
11,609. Fixing Ammonia for Manurial Purposes, R. Nicholls, London.
11,610. Preventing Concussion in Water Pipes, G. E. Redfern.—(*G. Richert, Sweden.*)
11,611. Applying Pressure to the Rolls of Machinery for Crushing Grain, J. Cartwright, London.
11,612. Adding Machine, G. F. Redfern.—(*A. Lapeyre, France.*)
11,613. Press Copying Letters, &c., G. A. Sweetser, London.
11,614. Serving Rope for the Rigging of Ships, T. Johnson, London.
11,615. Measuring and Controlling Electrical Currents, J. H. Davies, London.
11,616. Compositions for Polishing, A. Wilkinson, London.
11,617. Tires for Velocipede Wheels, A. M. Markham, London.
11,618. Expression of Juice from the Sugar Cane, W. Thomson, J. Mylne, and J. B. Alliott, London.

30th September, 1885.

11,619. Thimbles, O. G. Goodman and W. H. White, Birmingham.
11,620. Bosses of Perambulator Wheels, G. P. Lee, Manchester.
11,621. Waterproof Cloak, I. Frankenburg and J. Gronnowsky, Manchester.
11,622. Music Lined Paper, J. Tatton, Manchester.
11,623. Centrifugal Break-scalping and Flour-dressing Machines, A. Steiger, London.
11,624. Utilisation of Waste Tin, &c., E. R. Blundstone, London.
11,625. Non-slipping Velocipede Pedals, C. W. Lee, Wolverhampton.
11,626. Metallic Bedsteads, S. I. Whitfield, Birmingham.
11,627. Automatic Inclined Tramways, J. Heath and W. Frost, Longton.
11,628. Applying Metallic Reflectors to Jewellery, R. W. Hewett, Birmingham.
11,629. Weighing Apparatus for Attaching to Carts, D. France, Manchester.
11,630. Castors, S. Ryder, jun., Manchester.
11,631. Horse Boot Shoe, J. G. Smeaton, London.
11,632. Horizontal Fluid Steam Ventilators, A. J. Lehmann, Liverpool.
11,633. Bending Edges of Sheet Metal, D. Smith, jun., London.
11,634. Porcelain Enamel Baths, L. A. Brode, Glasgow.
11,635. Cotton Cords, D. Madeley, Manchester.
11,636. Boots and Shoes, J. Blakey, Halifax.
11,637. Magnetic Rotary Machine for Separating Iron and other Filings, W. P. Thompson.—(*H. Lamprecht, Germany.*)
11,638. Closing Bottles, W. Stott, London.
11,639. Composition to Prevent Rust of Metallic Surfaces, R. Oliver and J. H. Crane, London.
11,640. Gig Mills, C. E. Moser.—(*M. Grosselin, France.*)
11,641. Roller Mills, R. Smith, London.
11,642. Boots, &c., S. Lennard, London.
11,643. Lubricators, W. Thorp, London.
11,644. Making Casks or Barrels, F. Andrew, Lee.
11,645. Railway Signalling, H. J. Gardner.—(*C. D. Tisdale, United States.*)
11,646. Producing Light and Heat, F. Ducher and A. Serraillier, London, and T. Piéplu, Paris.
11,647. Opening the Points of Tramways, T. Falconer, Manchester.
11,648. Justification of Copy for Typographical Composition, P. M. Justice.—(*W. H. Knowles, France.*)
11,649. Cisterns, &c., J. King, London.
11,650. Flower-pot Frame, H. J. Haddan.—(*E. Bruel and L. Brunat, France.*)
11,651. Driving Punkahs, E. Zeller.—(*C. Steiner, Argentine Republic.*)
11,652. Plates for Voltaic Batteries, T. J. Jones and W. H. Tasker, London.
11,653. Metal-bodied Rubber Type, E. M. Richford, London.
11,654. Bicycles, J. E. Humphris, London.
11,655. Saddles, G. Smith, London.
11,656. Governors for Engines, A. T. Booth, London.
11,657. Linseed Cotton Cakes, J. Bibby, London.
11,658. Casks and Barrels, G. F. Redfern.—(*P. Chasseur, Algeria.*)
11,659. Battery Jars, H. G. Ellery and J. T. Gent, London.
11,660. Treating Fibres from Barks of Plants, G. F. Redfern.—(*E. F. and V. Urbain, France.*)
11,661. Seats, C. Groombridge and J. P. Rickman, London.
11,662. Washing Bottles, L. Percheron.—(*I. Rouhier, Mauritius.*)
11,663. Preserving Fruit, &c., S. Fulda, London.
11,664. Light and Heat by the Combustion of Hydrocarbons, J. Foord and W. W. Paddon, London.
11,665. Light Ventilating Abdominal Belt, H. Fisher, London, A. B. Soar, Hendon, and H. Potter, London.
11,666. Pocket Saws, F. Thompson, London.
11,667. Knitting Machines, H. H. Lake.—(*P. P. Olsson, Sweden.*)
11,668. Lubricating Apparatus, J. A. and J. Hopkinson, London.
11,669. Bodies of Harmoniums, &c., N. Berry, London.
11,670. Railway Chair, J. Medworth and F. Powell, London.

1st October, 1885.

11,671. Dissolving Vulcanised India-rubber, &c., J. Bagnal, London.
11,672. Tobacco Pipes, W. Holt, Manchester.
11,673. Packing for Glass Tubes of Water Gauges, H. Hallworth and J. L. Shorrock, Manchester.
11,674. Medicinal Application of Chloride of Ammonium Vapour, C. Symes, Liverpool.
11,675. Doubling Yarns of Driving Bands for Spindles, R. Ashton, London.
11,676. Terry Weaving, E. T. Broadhurst, and E. Smith, Manchester.
11,677. Screw Drivers, H. Shaw, Birmingham.
11,678. Automatic Steering Head for Bicycles, &c., T. M. Schofield, Manchester.
11,679. Air, &c., as a Motive-Power, R. Scott, Newcastle-on-Tyne.
11,680. Sanitary and other Traps, F. Gowing, Birmingham.
11,681. Aerated Liquids, H. Cochrane, Dublin.
11,682. Bedstead and other Knobs, J. Parry, Birmingham.
11,683. Centreing and Focussing Nose-piece for Microscope Objectives, A. Frazer, Edinburgh.
11,684. Drying Bricks, &c., W. Jones, London.
11,685. Blow-back Safety Valves, J. McEwen London.
11,686. Charge Receptacles for Submarine Mines, J. P. Gibbins, London.
11,687. Mechanical Filter, A. P. Laurie, Glasgow.
11,688. Wool Wadding for Garments, R. S. Moss, London.
11,689. Metal Wire, &c., C. M. Pielsticker, London.
11,690. Water-closets, E. J. D. Lucas, London.
11,691. Making Cartridges, W. Barnes, London.
11,692. Opening and Closing Fanlights, H. King, London.
11,693. Withdrawing the Bush and Spokes from the Nave of Cart and other Wheels, W. Halsall, London.
11,694. Lifts, F. Simmons and J. Williams, London.
11,695. Kitcheners, &c., H. Thompson, London.
11,696. Zither, C Kaltwasser, London.
11,697. Stringed Musical Instrument, G. E. Mason, London.
11,698. Water Tap, J. Rae, London.
11,699. Measuring Electric Currents, B. M. Drake and J. M. Gorham, London.
11,700. Moving the Bellows of Organs, L. A. Groth.—(*A. Allmuth, Germany.*)
11,701. Registering the Score in Games, R. K. Messent, Westminster.
11,702. Metallic Ballot and other Boxes, F. James, London.
11,703. Carriage Bodies, H. H. Leigh.—(*Horcher and Falck, Germany.*)
11,704. Joint Chair, H. H. Perry, Croydon.
11,705. Ploughs, W. H. Perram.—(*Messrs. G. Wilkinson and Co., Canada.*)
11,706. Laminated Springs, A. Lenz.—(*F. Kamper, Austria.*)
11,707. Controlling Electric Currents, O. E. Woodhouse, F. L. Rawson, and J. H. Davies, London.
11,708. Clinical Thermometers, H. St. G. Boswell, London.
11,709. Pumps, E. Edwards.—(*G. Bernard, France.*)
11,710 Repairing the Walls of Shafts, &c., W. Müller.—(*H. Ommelman, Germany.*)
11,711. Armour-plating of Vessels, E. C. G. Thomas.—(*H. S. Thomas, India.*)
11,712. Abutting Drills, R. H. Woodley, London.
11,713. Illuminating Gas, H. Howell, Liverpool.
11,714. Mouthpieces for use in Smoking Cheroots, &c., G. Watts, Liverpool.
11,715. Shafts for Screw Propellers, T. Robinson, London.
11,716. Ventilating Sewers, M. Holt, London.
11,717. Governing Apparatus for Steam Engines, &c., J. G. Joicey and M. Watson, London.
11,718. Raising and Forcing Water, W. H. Thompson, Lewisham.
11,719. Studs and Solitaires, W. A. Barlow.—(*E. Peine and Co., Germany.*)
11,720. Rotary Engines, W. A. Barlow.—(*G. Dietz and E. Tamsen, Germany.*)
11,721. Advertising, E. Tuteur, London.
11,722. Boring and Tunnelling Rocks, &c., J. A. McKean, London.

2nd October, 1885.

11,723. Pneumatic Pumps, C. F. Cooke, Halifax.
11,724. Drilling Machines, J. Midgley, Halifax.
11,725. Carpet Beating Machines, C. Foreman and T. Harrison, Halifax.
11,726. Improving Viscosity of Oils, W. and H. Marriott, Halifax.
11,727. Pneumatic Pumps, C. F. Cooke, Halifax.
11,728. Decorated Glass Ware, H. F. Webb, Birmingham.
11,729. Photographic Background Frame, G. W. Morgan, Aberdeen.

11,730. Ploughs, T. H. Buddle, Sandwich.
11,731. Sharpening Wire Ends, G. and E. Ashworth, Manchester.
11,732. Swells for Fast Reed Looms, C. C. Stout, Stockport.
11,733. Trousers, H. J. Allison.—(*R. B. Jentzsch, Austria.*)
11,734. Safety Catches for Windows, G. G. Brodie, Handsworth, and J. D. Prior, London.
11,735. Restoring Steam to Boilers, W. Robson, Newcastle-on-Tyne.
11,736. Embossing Designs on Leather, T. S. Brooks, London.
11,737. Matrices for Stereotype Plates, F. B. Welch, Manchester.
11,738. Apparatus for Extinguishing Fires, F. B. Welch, Machester.
11,739. Taps for Barrels, &c., B. E. Saunders, Birmingham.
11,740. Complete Correspondence Register, J. Hatfield, London.
11,741. Attachments for Metal Ropes, W. Foggin, Durham.
11,742. Ornamenting Plated Goods, H. Pearson and G. Walkland, Sheffield.
11,743. Indestructible Duplicate Railway, J. H. Yeo, Brixham.
11,744. Cutting Soap into Lengths, T. McGuffie, Liverpool.
11,745. Inflexible Truss Bed, H. Boddy, Ripon.
11,746. Mounting, &c., Large Guns, Sir E. J. Reed, London.
11,747. Utilisation of Alkali Waste, R. Fullarton, Glasgow.
11,748. Life-saving Mattress, Bag, &c., J. N. Cosbey, London.
11,749. Counting &c., Strokes of Engines, W. P. Thompson.—(*W. Voit, Germany.*)
11,750. Disposing of Sewage, T. Mercer, Liverpool.
11,751. Venetian Blinds, W. Clarke, Liverpool.
11,752. Bell Ringing, A. G. Brookes.—(*P. J. Schröder, Germany.*)
11,753. Pickling Metal Plates, R. Evans, London.
11,754. Sewing Machines, F. Quenstedt and R. Gellert, London.
11,755. Feeding Paper to Machines, T. Maguire, London.
11,756. Governors, E. Wigzell and J. Pollit, London.
11,757. Velocipede Saddles, W. D. McCoy, London.
11,758. Fastening, &c., Jewellery to Dress, F. Bott, London.
11,759. Water Meters, O. Imray.—(*The Société Michel et Cie., France.*)
11,760. Wheel Carriage and Harness, T. B. Sharp, London.
11,761. Heating and Cooling Liquids, T. B. Sharp, London.
11,762. Ventilators, E. Hatton, Manchester.
11,763. Heating Ovens, W. W. Griffin, Liverpool.
11,764. Frames for Tram-car Life-guards, W. C. Edwards and J. Record, London.
11,765. Shifting Driving Belts or Pulleys, E. Edwards.—(*Revardeaux-Dumont, France.*)
11,766. Curler for Human Hair, R. R. Beard.—(*J. Deutschbien, Luxembourg.*)
11,767. Electrical Current Measurer, H. F. Joel, Dalston.
11,768. Over-edge Sewing Machines, W. Webster, London.
11,769. Lamp Chimneys, W. L. Wise.—(*C. H. Knoop, Saxony.*)
11,770. Operating Brakes, &c., O. Olson, London.
11,771. Dovetailing, Mortising, &c., Machines, J. Knott, London.
11,772. Fire Extinguishers, G. A. Morison, London.
11,773. Copying Press, H. Griffin, London.
11,774. Steam Engines, B. C. Waite, London.
11,775. Screwing Boots and Shoes, &c., W. H. Beck.—(*C. Halma, France.*)

3rd October, 1885.

11,776. Adhesive Stamps or Tickets, G. S. Richardson, London.
11,777. Adhesive Carrier, L. Warnerke, London.
11,778. Automatic Steering for Tricycles, J. D. Thompson, Brighton.
11,779. Carts, A. F. Sanderson, London.
11,780. Attaching Heels to Boots, W. J. Boyle, Liverpool.
11,781. Vacuum Brake Gauges, C. S. Madan, Manchester.
11,782. Brushing the Hair, J. Willis, Great Malvern.
11,783. Pickers for Looms, R. Clayton, Manchester.
11,784. Velocipede Saddles, L. Taylor, Birmingham.
11,785. Boards for Teaching the Principles of Geometric Drawing, G. C. Pringle.—(*J. M. Pringle, New South Wales.*)
11,786. Coupling for the Harness of Draught Animals, H. R. Landon and I. Hurn, London.
11,787. Infants' Feeding Bottles, J. G. Ingram, London.
11,788. Electric Meter, A. P. Chattock, London.
11,789. Fabricated and Decorated Pictures, A. Gems, Sidcup.
11,790. Paving, J. Lewthwaite, London.
11,791. Match Stands, J. J. Beaumont and H. Holdsworth, Sheffield.
11,792. Coupling Apparatus for Railway Wagons, W. Mosley, London.
11,793. Movable Step for Velocipedes, E. G. Colton.—(*F. Mencke, Germany.*)
11,794. Carpets, G. Marchetti, London.
11,795. Beam Scales, W. B. Avery, London.
11,796. Counting Needles, R. S. Bartleet and W. Tandy, London.
11,797. Velocipedes, W. H. Dunkley, London.
11,798. Extracting Iron from Ores, O. Imray.—(*L. Bondy, Austria.*)
11,799. Producing Letters on Marble, &c., W. H. Beck.—(*J. Hayem, France.*)
11,800. Metal Tubes, F. Elmore, London.
11,801. Steam Boilers, J. McAllister, Glasgow.
11,802. Tin and Terne Plates, A. J. Maskrey and W. Jones, Glasgow.
11,803. Delivering Goods in Exchange for Coin, J. and S. W. Lewis, London.
11,804. Making Bale-ties, H. C. Capel, London.
11,805. Flushing Cisterns for Waterclosets, H. A. Phillips, Hull.
11,806. Cement, W. T. Timewell, London.
11,807. Bending Rails, &c., F. C. Dixon and J. Abbott, London.

5th October, 1885.

11,808. Glass-holders, G. Marris, Birmingham.
11,809. Matches, W. B. Thomson, Wick, N.B.
11,810. Portable Extension Ladders, J. Neild, Manchester.
11,811. Joiner's Bench Knife, J. Gurr, Brighton.
11,812. Secondary Batteries, J. C. and G. Fuller, London.
11,813. Holder for Incandescent Lamps, J. C. and G. Fuller, London.
11,814. Covers for Hot-water Jugs, &c., E. Taylor, Alsager.
11,815. Mixers for Gas and Air Burning Smoothing Irons, E. Winnington, Belfast.
11,816. Examining the Barrels of Breech-loading Guns or Rifles, W. Gregory, London.
11,817. Sash, Casement, &c., Fasteners, W. Sanderson and T. A. Moffitt, Birmingham.
11,818. Ejectors, R. M. Deeley, jun., Derby.
11,819. Boring Tools, W. Sanderson and T. A. Moffitt, Birmingham.
11,820. Legging and Boot Studs, J. Stoneman, Plymouth
11,821. Perforated Fire-clay Bottom for Ranges and Stoves, M. Bousfield, York.
11,822. Circular Telegram Code, A. Emerson, London.
11,823. Engines, W. B. Thompson, Glasgow.
11,824. Chimney Sweeping Apparatus, J. and A. Grozier, Glasgow
11,825. Constructing Roads, W. Sowerby, Acton.
11,826. Attachment to Gas-burners, W. H. Howorth, Halifax.
11,827. Treadle Motion for Sewing Machines, &c., S. Spencer and T. Pendlebury, London.
11,828. Automatic Continuous Spring Brake, R. W. O. Kestel and A. McFarlane, South Australia.
11,829. Screw-threaded Nails, W. T. McGinnis, London.
11,830. Warp Lace Machines, J. Hudson and J. Jardine, London.
11,831. Leather Sculpture Ornaments, O. C. Grosse and F. A. Haase, London.
11,832. Fire-escape, T. L. Pulman, London.
11,833. Siphon Cisterns for Flushing Water-closets, W. D. Scott-Moncrieff, London.
11,834. Gas Motor Engine, W. Muir, Edmonton, and D. C. Smith, London.
11,835. Feed-water Heater, G. Walker, London.
11,836. Treating Phosphatic Earth, N. B. Powter, London.
11,837. Stays and Corsets, M. L. Barlow, London.
11,838. Horseshoes, J. J. Snook, London.
11,839. Steam Engines, W. H. Wheatley and J. W. MacKenzie, London.
11,840. Lock Spindles, G. G. Bussey, London.
11,841. Sweetmeats, H. Schooling, London.
11,842. Centrifugal Machines for Separating Liquids, J. Gray, Glasgow.
11,843. Planing Machines, R. A. Baillie and L. Chapman, London.
11,844. Gill Boxes, I. Willems and E. Depoortez, Liverpool.
11,845. Drawing Combed Textile Fibres, E. Maertens, London.
11,846. Hand Grenades for Extinguishing Fire, H. H. Lake.—(*E. G. Rideout, U.S.*)
11,847. Umbrellas, &c., E. H. White, London.
11,848. Propelling Ships, E. Brown, London.
11,849. Wire Mat, F. C. Guilleaume, London.
11,850. Preventing Induction in Telegraphy, W. L. Wise.—(*J. Rae and J. C. Simpson, Canada.*)

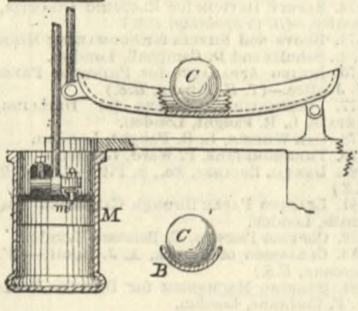
SELECTED AMERICAN PATENTS.

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

324,459. Governor for Steam Engines, *George H. Corliss, Providence, R.I.—Filed June 13th*, 1885.

Claim.—The combination of a centrifugal governor with a lever, as B, and a rolling ball, as C, and a piston

324,459

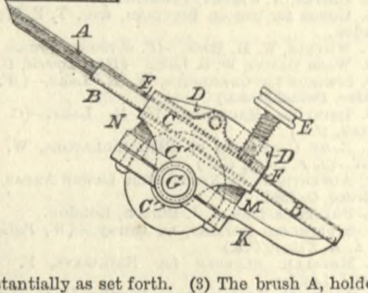


M, having an adjustable opening *m*, working easily in a cylinder containing liquid, all arranged for joint operation, as herein specified.

324,590. Commutator Brush for Dynamo or Magneto-electric Machines, *Joseph A. Powers, Troy, N.Y.—Filed March 13th*, 1885.

Claim.—(1) The brush of wires or plates and a holder C, a pivotted cap D, and clamping screw E, in combination with a spring plate F, between the cap D and brush, and extending beyond the cap, substantially as set forth. (2) The stud or gudgeon G having a shoulder at *h*, in combination with the brush A, holder C, lever K, spring M, and clamping nut L,

324,590

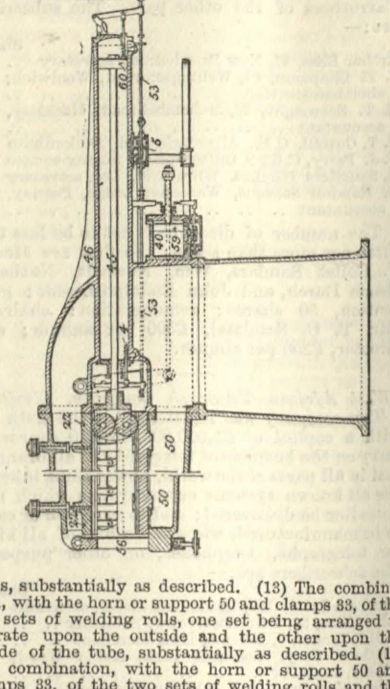


substantially as set forth. (3) The brush A, holder C, cap D, and screw E, in combination with the stud G, passing through holes in the flanges C^1 of the holder C, the lever K upon the stud G, the springs M N, extending out from such lever K and acting against the under side of such holder C, and the clamping nut L, substantially as set forth.

324,610. Machine for Welding Tubes, *George S. Strong, Philadelphia, Pa.—Filed July 14th*, 1884.

Claim.—(1) In a machine for welding tubes, the combination, with a support adapted to enter the tube, of clamps arranged to clamp the tube upon each side of the seam, a roll or rolls arranged to be passed back and forth along said seam, and means for operating said roll or rolls, substantially as described. (2) The combination, with a support adapted to enter the tube, of clamps arranged to clamp the tube upon each side of the seam, a roll or rolls arranged to be passed back and forth along said seam, means for operating said roll or rolls, and an adjustable track-bar arranged to press said roll or rolls against the seam, substantially as described. (3) The combination, with the horn or support 50, of clamps arranged to clamp the tube upon both sides of the seam, a roll or rolls arranged to be passed back and forth along said seam, and means, as the yoke 56, for supporting the outer end of said horn or support, substantially as described. (4) The combination, with the horn or support 50, of clamps arranged to clamp the tube upon both sides of the seam, a roll or rolls arranged to be passed back and forth along said seam, an adjustable track-bar arranged to press said roll or rolls against the seam, and means, as the yoke 56, for supporting the outer end of said horn or support, substantially as described. (5) The combination, with the horn or support 50, of the clamps arranged to clamp the tube upon both sides of the seams, and the cylinder 40, piston 59, and connections for operating said clamp, substantially as described. (6) The combination, with the horn or support 50, of the clamping bars 33, arranged to clamp the tube upon both sides of the seam, and the cylinder 40, piston 59, toggle joints 29 31, and connections for operating said clamping bars, substantially as described. (7) The combination, with the horn or support 50, of the rolls, adjustable track bar 22, and the cylinder 46, piston 60, and connections for operating said rolls, substantially as described. (8) The combination, with the horn or support 50, of the clamps for clamping the tube upon both sides of the seam, the welding roll or rolls, and the cylinder 46, piston 60, and connections for operating said roll or rolls, substantially as described. (9) The combination, with the horn or support 50, of the clamps for clamping the tube upon sides of the seam, the welding rolls, the adjustable track bar 22, and the cylinder 46, piston 60, and connections for operating said rolls, substantially as described. (10) The combination, with the horn or support 50, of the clamps 33, the welding rolls, the adjustable track bar 22, the yoke 56, and the cylinder 46, piston 60, and connections for operating said rolls, substantially as described. (11) The combination, with the welding rolls, of the cylinder 46, piston 60, piston rod or rods 45, valve 5, and connections by which said valve is automatically reversed as the piston nears the end of each stroke, substantially as described. (12) The combination, with the welding rolls, of the cylinder 46, piston 60, piston rod or rods 45, valve 5, valve rod 53, tappet rods 4, and connec-

324,610

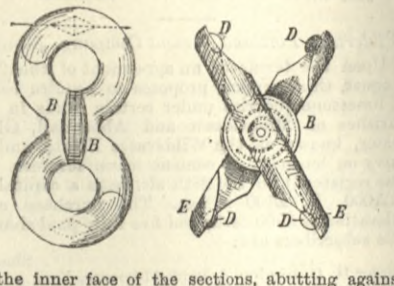


tions, substantially as described. (13) The combination, with the horn or support 50 and clamps 33, of the two sets of welding rolls, one set being arranged to operate upon the outside and the other upon the inside of the tube, substantially as described. (14) The combination, with the horn or support 50 and clamps 33, of the two sets of welding rolls and the two adjustable track bars 22, 61, substantially as described.

324,637. Open Link, *Thomas Barnes, Philadelphia, Pa.—Filed June 3rd*, 1885.

Claim.—(1) A link formed of sections shaped substantially as described, having central pivotted bearings, the latter being recessed and containing a spring, the ends of which are connected with the two sections, substantially as described. (2) An open link, consisting of sections shaped substantially as described, centrally pivotted together, having their bearings recessed, with a spring therein, and lugs and recesses

324,637

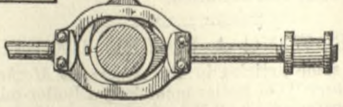


on the inner face of the sections, abutting against each other when the link is closed, substantially as described. (3) An open link formed of two sections having a central bearing B, each section having at each end thereof the projection D and recess E, adapted to interlock when the link is closed, substantially as described.

324,784. Valve Gear, *Delmar D. Pinkham, Longview, Tex.—Filed June 15th*, 1885.

Claim.—(1) The combination, with a shaft, of cams of different projections, one being adjustable, and a

324,784

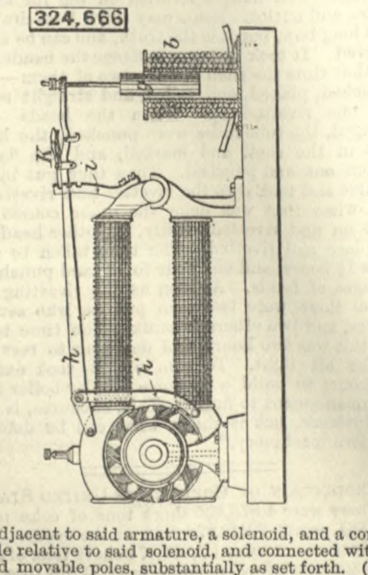


yoke having at each end and on each side thereof adjustable lugs or bearings, substantially as and for the purpose specified. (2) The combination, with a shaft, of cams of different projection thereon, one being adjustable, a loose friction collar of cylindrical shape on the shaft between the cams, a yoke surrounding said collar, and adjustable lugs or bearings on each side of each end of the said yoke, substantially as and for the purpose specified.

324,666. Regulator for Dynamo-electric Machines, *P. Diehl, Elizabeth, N.J.—Filed September 8th*, 1884.

Claim.—(1) The combination with a revolving armature of a field-magnet having one or more movable

324,666

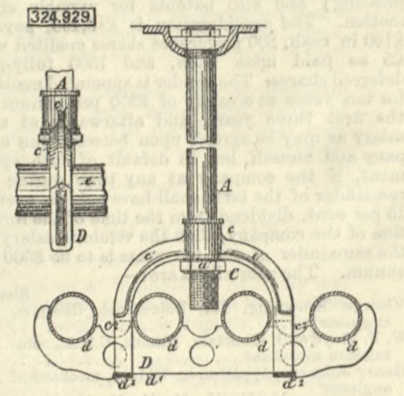


poles adjacent to said armature, a solenoid, and a core movable relative to said solenoid, and connected with the said movable poles, substantially as set forth. (2) The combination with a revolving armature of an electro-magnet having a movable pole adjacent to said armature, a solenoid, a core movable relative to said solenoid, and a lever connected with said pole and core, whereby as the strength of the current passing through said solenoid is increased the said pole will be moved away from said armature, and *vice versâ*, substantially as set forth. (3) The combination with the armature of the magnet having fixed and pivotted portions and pole-pieces, the fulcrum bar h^1, the lever *h*, bar *i*, detent K, solenoid *b*, and movable core *g*, adjustably connected with said lever *h*, substantially as set forth.

324,929. Support for Steam Pipes, *John Finnegan, Philadelphia, Pa.—Filed March 14th*, 1885.

Claim.—(1) In a pipe supporter or hanger, the combination, with the yoke C, having arms c^1 c^1, slotted at or near their lower ends, of the continuous supporting bar D, arranged within the slots c^2, and having the pipe seats *d* on its upper edge and the shoulders d^2

324,929

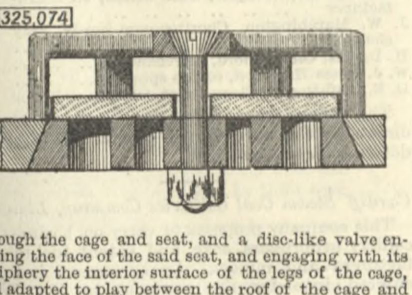


on its lower edge. (2) In a pipe supporter or hanger, the combination, with the threaded pipe or hanger A and the adjusting nut a^1, of the yoke C, having slotted or mortised arms c^1 and the supporting bars D, projecting through the slots c^2, and formed with the pipe seats *d* on its upper edge and the shoulder d^2 on its lower edge, substantially as described.

325,074. Blowing Engine Valve, *Fred. W. Gordon, Pittsburg.—Filed May 15th*, 1884.

Claim.—(1) In a blowing engine valve, a valve-holding plate provided with an opening for a valve-seat, a disc-like seat disposed within such opening, and removable from the outside of the plate, a disc-like valve engaging the face of the seat, a spider-like cage with its legs resting upon the side of the plate opposite to the side from which the seat is inserted, and a bolt passing through the cage and seat, and serving to hold the seat in the opening of the plate, and the cage against the face of the plate, combined substantially as and for the purpose set forth. (2) In a blowing engine valve, a plate provided with a grated valve seat, a spider-like cage with its legs resting upon said plate around said seat, a bolt passing

325,074



through the cage and seat, and a disc-like valve engaging the face of the said seat, and engaging with its periphery the interior surface of the legs of the cage, and adapted to play between the roof of the cage and the seat, combined substantially as and for the purpose set forth. (3) In a blowing engine valve, a plate having a circular opening, a disc-like seat engaging such opening from one side of the plate, a cage with its legs resting upon the other side of the plate around said opening, a bolt engaging the cage and serving to clamp the plate between them, and a disc-like valve playing upon the seat within the cage, combined substantially as and for the purpose set forth.

325,079. Steam Engine, *Wm. E. Hill, Kalamazoo, Mich.—Filed July 11th*, 1884.

Claim.—(1) A steam chest and connected engine cylinder, the former having an induction port each side of the longitudinal centre, and a central main exhaust port, the latter having a main exhaust port leading centrally into the steam chest, and both having communicating ports as follows:—An exhaust port for each end of the steam chest, one leading from the right-hand end to the central portion of the cylinder at the left of the cylinder main exhaust port, the other leading from the other end of the chest to the right of said main exhaust, a cylinder exhaust port leading from each end of the cylinder into the

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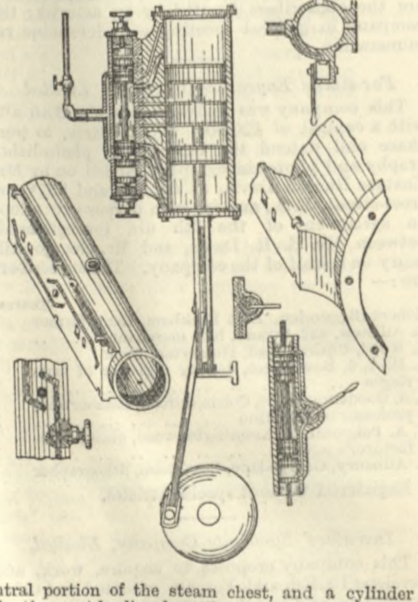

central portion of the steam chest, and a cylinder induction port leading from the steam chest into each end of the cylinder, in combination with valve pistons in the chest and the cylinder arranged to open and close said communicating ports, and the valve pistons in the chest being also arranged to register the steam chest and cylinder induction ports, all substantially as set forth. (2) A steam chest having a steam actuated valve therein, and provided at the ends with adjustable head blocks to govern the longitudinal size of the interior of the chest, for the object stated, substantially as set forth. (3) A steam chest having a steam actuated valve therein, a passage leading from the main induction port, and branching into each end of the chest, and a one-way plug at the juncture of said passage and branches, for the object stated, all substantially as set forth.