TIDAL ESTUARIES, AND THE BAR OF THE MERSEY.

By W. H. Wheeler, M. Inst. C.E.

The room in which Section G of the British Association holds its meetings is generally the least attractive of those of which the Association is composed. At Manchester, however, an unusually large audience attended to hear the papers read by Mr. Leader Williams, on "The Manchester Ship Canal," Mr. Shelford on "The Bar of the Mersey," and Professor Osborne Reynolds on "The Movement of Sand in Estuaries."

The subject dealt with by Mr. Shelford is one of more than local interest, or as affecting the interest of Liverpool only, and may be considered of national importance. The principal trade between America and this country passes through the Mersey. From America we derive enormous supplies of raw material and food, which afford employment and the means of subsistence and wealth to a very large portion of the population of this country. Across the bar of the Mersey, outwards, passes the largest tonnage of goods manufactured in this country of any port in the kingdom. The passenger traffic passing over the Mersey assumes larger proportions every year. Millions of money have been spent in providing accommodation for this traffic and manufacture. Docks, railways, warehouses, factories have absorbed an appreciable amount of the total capital embarked in such enterprises. The expenditure on steamships for conveying this traffic has assumed an immense total, and every year fresh capital is laid out in new and improved vessels, that compete with one another to shorten the time occupied in crossing the Atlantic by a few hours. Yet between the two countries is the bar of the Mersey, and a steamer that has covered the 3000 miles of ocean travelling in little more than a week is frequently detained four or five hours in the open sea, and prevented from reaching a safe anchorage in the river by this narrow ridge of sand known as "the Bar."

It is not as if there were any impossibility in removing this obstruction, or its being a case of accepting the inevitable. Engineers of the greatest eminence, from Mr. Rennie downwards, have reported and pointed out the method of overcoming it. It is a mere matter of money. Mr. Shelford in his paper pointed out the manner by which, without any works of heroic magnitude, the bar could be swept away. In this opinion he was supported by engineers of such world-wide standing as Mr. Abernethy and Sir Jas. Douglas. Admiral Spratt, in his last report to the Conservators of the Mersey, expressed the opinion that the deepening of the bar to a depth sufficient for ordinary navigable purposes was a work that came within the range of practical cost, or rather, to use his own words, that it would be a comparatively economical work.

A consideration of the particulars given by Mr. Shelford is, therefore, well worthy of the attention of all engineers interested in hydraulic engineering.

The greater part of Mr. Shelford's paper was historical, giving a description of the bar, and the various alterations which have taken place in its direction and depth. The principal alteration of the main tidal channel of the Mersey since 1833 has been a diversion northwards from the old Formby Channel, and the substitution for this, first of the Victoria, and then of the present or Queen's Channel. The depth at low-water spring tides has varied during the last forty years from 7ft. to 17ft. The depth at the present time is about 11ft. From an examination of the charts, the sand-banks at the bar do not appear to have made any advance seawards for the last century. This Admiral Spratt traces to the failure of a supply of pure siliceous sand. With this opinion, however, Mr. Shelford does not agree. The tide in Liverpool Bay has a rise of 30ft., and there is a strong current from the bay into and out of the Mersey, but there does not exist any along-shore current independent of this capable of removing detritus to a distance. The finer suspended matters are thus carried away by the ebb current to deep water, and Mr. Shelford considers that the great flow of tidal water is sufficient, if properly directed, to maintain such a navigable channel as will greatly reduce, if not altogether remove the present want of depth over the bar. The tidal force available for this purpose is put at 1500 million cubic yards of water, which pass and repass at each spring tide over the ridge of sand banks between New Brighton and Formby Point. It is contended that this quantity of tidal water is sufficient, when concentrated even approximately in one channel, to maintain the depth required for navigation. In support of this the fact is quoted that the present tidal flow is of sufficient power to maintain a channel 6000ft. wide at low water spring tides and from 24ft. to 48ft. deep for a distance of over nine miles from New Brighton. Admiral Spratt in the report already mentioned refers to the same circumstance, and contends that if the natural forces in existence are sufficient to maintain a channel over the bar 17ft. deep, as it was at one time, slight assistance by training would effect even greater results. Mr. Shelford then directs attention to the reports of Messrs. Murray and Giles of 1861, wherein they advised that every effort should be made to concentrate the various exits for the water into one, in order to maintain the full scour of the ebb on the bar. From a study of an excellent model which Mr. Shelford had prepared to illustrate his paper, he argues that the tendency of the main channel is to extend northwards, and that the general direction of the Queen's Channel is towards the deepest water in the bay, and that therefore in any efforts at improvement the present course should be maintained as the best possible access to the Mersey. That the prevalence of shallows and shifting sands on the south side of the Burbo banks renders extremely undesirable the opening of a new channel in that direction. Mr. Shelford is of opinion that dredging would not provide an effectual remedy, and that a dredged channel would not be self-maintaining on account of the tendency of the flow and ebb to take separate courses. In any remedial works carried out it is suggested that the following points should applied: (1) That there should be the least possible interference with the present tidal current of the bay. (2) That as the best means of conserving the channel, the Burbo banks should be maintained, or rather increased. (3) The concentration as far as possible of the flood and ebb streams in one channel. This could be accomplished by extending the Burbo sands seawards, and so restricting the width of the low-water channel over the bar. It is proposed to do this by the deposit of mounds of rough stone, protected where necessary by blocks of large size, the mounds being carried four feet above low water spring tides.

The paper contributed by Professor Osborne Reynolds, as the result of his observations on the movement of sand in estuaries, is a valuable contribution to the knowledge already possessed on this subject.

The conclusion he has arrived at is that the lowering or raising at any time of the bed of a sandy estuary depends solely on the character of the motion of the water; and although disturbances may take place from time to time from abnormal causes, the same condition as to the shape of the sand will ensue when these causes are removed.

An extremely ingenious and interesting working model of the upper estuary of the Mersey has been constructed by the Professor, and was exhibited in working order at Owens College during the meeting of the British Association. The horizontal scale is in the proportion of six inches to a mile, and the principal features of the coast-line are faithfully reproduced, as are also all the deeps and shoals of the hard bottom, as far as could be gathered from the charts.

This hard and permanent bottom was covered by a layer of loose sand, having its upper surface perfectly flat. The area embraced by the model extends from Warrington to New Brighton. At the lower end is a vessel containing water. This is gradually raised and lowered at short and regular intervals, the raising causing the water to flow up the narrow channel, past Liverpool, into the upper estuary; and the lowering bringing back the return ebb current. This movement is kept on continuously several hundred times, and occurs at intervals of about 1½ minutes. The water thus passing up and down is intended to represent the ebb and flow of the tide. It must be gratifying, after all the ingenuity and trouble which Professor Osborne Reynolds has expended on this model, to find how nearly the effect produced is a faithful picture of the condition of the upper estuary. The position and relative size and direction of the various channels—both flow and ebb—are clearly developed. The Sloyne deeps and all the other features gradually produced themselves in the surface of the sand, proving the theory that under like conditions, with regard to the motion and direction of water through sand-beds, similar results will ensue. The oscillating motions of the particles of sand and alluvium are distinctly seen, especially when pools occur, and if any single particle be watched, it will be seen rolling over along the bottom, passing into the pool on one side and out again on the other. If large and heavy, returning again with the reverse current, or, if light, carried further away.

Mr. Shelford's paper touched only very casually on the cause of the formation and continuance of the bar at the mouth of the Mersey, and it may be of interest therefore to refer to this.

Sand is thrown up by the waves during on-shore gales all along this part of the coast. The effect of this is to form a continuous line of ridge-shaped beach across the mouth of the river. Over or through this ridge the inflowing and ebbing current of the river has to find its way. The continuous action of the ebb and flow of the tide results in a depression in one part, through which the first of the flood and the last of the ebb passes over, and which, although the deepest place along the ridge of sands, is yet shallower than the channels on either the inner or outer side, and constitutes the feature known as "the Bar." The submerged sand of the bar is always in motion, and regularly oscillating backwards and forwards with the flood and ebb currents. The ebb, being a descending current, naturally has the greatest effect, the lighter particles of alluvial matter brought down from the river being carried away by it never to return, and only the heavier particles of silica thrown up by the waves are left to oscillate backwards and forwards. The quantity thus left to form the bar in its mean condition is the balance of the forces of the waves to produce material and the tidal currents to remove it. The height and size of the bar varies from time to time within certain limits, as gales or heavy floods may add to or diminish the supply of material passing over it. After inshore gales the bar increases in size, the available depth of water over it diminishing accordingly. In most rivers, during heavy floods, when the ebb has a preponderating influence over the flood, the bar diminishes, a large proportion of material being carried away to deep water. After a time, when the normal conditions have had time to assert themselves, the bar returns to its mean size. The position and shape of the bar is due to special local causes. Thus the position of the depression in the sand ridge, where the bar of the Mersey is at the present time, is no doubt due to the direction given to the ebb current by the concave form of the channel from Liverpool downwards. The upper part of this channel has been considerably altered and its course regulated by works carried out during the construction of the works on its margin. Its present shape is a regular curve from the landing-stage at Liverpool to the outer end of the Jordan Sand, where the bar is, and it is therefore in the best possible form for maintaining a good channel.

The shape, or profile of the bar, and the fact of the existence and continuance of a ridge-shaped shoal rising thirty feet above the bed of the sea, the material of which it is composed having no adhesive properties, and the particles which are therefore easily moved in water, in a position where the concentrated energy of a large volume of flowing water is continually passing over it, is due to the laws which govern the movements of the currents in rivers and estuaries. The action causing the ridge may be described as primarily due to the rotary motion of the individual particles of water which roll round one another in their forward motion, imparting a tendency to the whole mass to assume a curved course rather than one parallel to the plane in which it is moving. It is due to this action—aided by the greater or less resistance of the materials composing the bottom and sides of the channel through which water flows, which by yielding in one part and resisting in another cause deflections of the stream—that bends in the side, and the deeps or holes in the bottom occur. A stream under natural conditions never keeps a straight line either horizontally or vertically. In the Mersey the particles of water of the ebb current flowing vertically through the deep channel immediately above the bar are deflected when they come in contact with the sand ridge, and having to rise up and pass over this ridge, assume a circular motion in the same way that the horizontal planes do when passing round a concave bend. The heavy particles of sand in motion in the water are rolled up and carried a certain distance; the lighter particles are not only carried up, but a certain portion transported away. On the reversal of the tidal current the same operation takes place, the heavy particles being rolled back to their original position. The excess of material due to any detritus brought by the river is cleared away by the preponderating power of the descending ebb, and thus a mean condition is maintained. An inspection of Professor Osborne Reynolds' model of the Mersey clearly shows the action of an oscillating current on sand as thus described, the course of the different-sized particles being distinctly traceable. Under ordinary circumstances, and in the case of most bars, strong land floods, by further increasing the relative power of the ebb, result in a decrease of the sand constituting the bar, and a consequent temporary deepening of the water over it. In the Mersey, however, there are other causes operating which counteract this influence. The upper estuary consists of a wide expanse of shifting sands. These sands are constantly liable to be transported by the change in the position of the channels passing through them, due principally to large land floods. At this period the freshets prevail over the tidal influence and cause the existing channels to assume different directions. These changes in the sand, locally known as "frets," load the water flowing through them with sand and alluvium. The ebb current at these times passes down to the bar loaded with as much detritus as its transporting power is capable of holding, and thus supplies material for building up and adding to the bar.

The great "fret" of 1870 is reported to have caused the removal of nearly six million cubic yards of sand out of the upper estuary. Following this, the depth of water on the bar gradually diminished from 11ft. to 7ft. If the great changes or "frets" which have from time to time taken place in this estuary be examined, it will be found that an increase of the material on the bar has almost invariably followed.

The merits of the remedial action of fresh-water floods in removing bars is not so great as at first sight appears. The fresh water of the flood does not cause an additional quantity of ebb water to pass over the bar equal to that which comes down the upper reaches of the river above the influence of the tides; the fresh water only displaces a certain quantity of tidal water which otherwise would have flowed up the river. Further, the fresh water which thus displaces the tidal has not so great a scouring effect owing to its lighter specific gravity.

The popularly received idea, that bars are due to matter carried in suspension being deposited at the site where two opposing currents meet, or to a decrease of velocity of the current owing to the increased area of the space into which the channel discharges, is not borne out by facts, as there are instances where these conditions prevail where there are no bars, and of bars existing where the current carries little or no matter in suspension.

The matters of which bars in sandy estuaries are composed is of a size and specific gravity too great to be carried in suspension, and these bars are frequently situated a long distance from the embouchure of the river which alone could supply the detritus. The matter brought down in such cases is deposited at the head of the estuary many miles above the bar.

The state of equilibrium of a sand bar being reached and known, if a sufficiently preponderating influence can be given to the ebb current the bar must gradually disperse by more particles being carried out than are brought back, resulting in a deepening of the channel. This is not to be accomplished so much by increasing the tidal capacity of the reservoir above, as this, by admitting more tidal water, increases, although to a rather less extent, the power of the flood as well as the ebb, and so continues the balance of forces, but rather by taking advantage of the power due to the effect of gravity of the descending stream, and concentrating its energy on the space occupied by the bar.

No definite opinion of any value can be given as to the remedial measures best adapted for improving the navigation of the lower Mersey, except it be founded on a careful survey of all the surrounding circumstances. The proposed further investigations of Professor Osborne Reynolds, and the committee appointed by Section G, at Manchester, of the laws which govern the movement of sand in estuaries, will be of valuable service in elucidating this subject. The various suggestions which have been made may be of more or less value, according to the experience which their authors have had in similar works, or the attention they have devoted to this special subject. Mr. Shelford, who has devoted much attention to hydraulic engineering, proposes that means should be taken for preserving and continuing the line of the Great Burbo sands, by stone mounds or training walls; but it is a question worth consideration whether more effect would not be gained by carrying out work of this kind on the opposite or concave side of the channel, where the greatest velocity and scour must take place. By following and continuing the line of the Jordan sands, and taking measures to prevent any portion of the last of the ebb passing away to the north-east, over the Jordan flats, an immensely increased scouring action would be brought to bear on the bar. The concave form of the channel is favourable to the maintenance of the ebb and flood currents in one course; and it is possible that if this work were carried out no training would be required on the other side, but only the stopping up of the small lateral channels which pass through the Burbo sands and allow the escape of a large quantity of water which otherwise would have to pass over the bar. Dredging has been proposed as a more economical means of improving the bar than attempts to regulate the channel. It is obvious, however, that dredging, to be of service, must be a continuous, and therefore very costly work. As long as the conditions remain as they are now the same results will ensue, and the sand removed by a dredger would be replaced at the next inshore gale. A season's work might thus be undone during one storm, and the navigable depth of water reduced to its former dimensions; so remaining until the sand could be again dredged away.

Liverpool has an advantage over many ports on sandy coasts, in not having a strong littoral drift, carrying sand or shingle with it across the exit of the river. To this cause, notwithstanding the extensive remedial works which have been carried out, the entrance to Lowestoft Harbour can only be maintained by constant dredging. The same has been the case with many of the harbours on the French and Belgian coasts, where the projection of piers has resulted in a gradual growth of the coast line seawards, owing to the travelling matter being arrested in its course by the piers. Every further extension has resulted in a further growth, till the length of the piers has become so great that the entrances can only be maintained by sluicing reservoirs and dredging. The Mersey also differs from rivers discharging into tideless seas and carrying down with them an enormous amount of alluvium, which, being deposited at their mouth, forms immense deltas, through which the water has to find its way by several different wide and shallow outlets. In these cases training walls, as carried out in the Mississippi and the Danube, by concentrating the energy of the current in one channel, have imparted sufficient velocity to the current to enable it to act as its own transporter. An enormous mass of material has thus been carried away by the natural action of the current, leaving a deep navigable channel.

Works of this character would be useless on the tidal harbour of the Mersey, where the obstruction comes from the sea, and not from the river, and where the fresh water bears only an insignificant proportion to that of the tidal, the respective quantities given being two million cubic yards of fresh water and 500 million cubic yards of tidal. There are instances of rivers discharging on sandy coasts, and at times carrying large quantities of alluvium, which have no bars. The most notable examples in this country are the Thames, the Severn, and the Humber. The drainage area of these rivers is very large, that of the Thames being 6000 square miles, the Severn 8000, and the Humber 10,500 acres, as compared with 1706 square miles of the Mersey. The Humber perhaps carries the largest amount of alluvial matter of any river in this country, but not only is the relative size of its drainage area very large, but it is provided at its entrance into the North Sea, on one side, with a natural pier or groyne, made by the projection of Spurn Point, which directs the ebb current in the same course as that of the tidal flow in the sea, and causes the tide coming from the north to sweep round it and carry away any sand which might have a tendency to collect there. In Boston Deeps, which is only a few miles south on the same coast, there exists a bar. Here the rivers which discharge their waters to the sea by this outlet deposit any alluvial matter which they bring down, at the upper end of the estuary twenty miles away, and the only material for forming the bar is the sand drawn by the waves from a comparatively shallow sea, having only a depth of about 25ft. at low-water spring tide. In the adjacent entrance to Lynn Deeps, where the depth of the sea at the mouth of the bay is more than three times as great as that off Boston bar, the energy of the waves is expended before they reach a sufficient depth to disturb the sand, and therefore there is no sand that can be put in motion in gales to form a bar. A depth of from 10 to 15 fathoms is maintained at low-water spring tide up to the head of the estuary.

Although it is impossible, in dealing with a subject having so many different local disturbing causes as the bar of a river, to lay down any general plan for remedying it, it is of value to look to places where works carried out in harbours of somewhat similar character have been successful. For this purpose the harbour of Dublin may be selected. The Liffey has only a drainage area of 108 square miles, and discharges into Dublin Bay through large beds of sand. The deepest channel across these sands or the bar had 6ft. on the crest, with about 16ft. on either side. The works carried out consist of a training wall parallel with the course of the river on the south side, and on the north a wall or pier has been run out from the shore towards the bar at an angle of about 40 deg. to the river. This wall is carried above high water for part of the length, gradually dropping to low water as it approaches the bar. By this arrangement, while the whole scour of the ebb has been concentrated on the bar, no diminution has taken place in the area of the tidal reservoir above the bar, but rather it has been increased by the dredging carried out for the improvement of the river. The bar has in this way by scouring action alone been reduced 10ft., giving an equally increased depth of water over it. Another example of the effect produced in part by induced tidal scour is that of the Tees, the estuary of which is encumbered by sand. Two converging walls from the north and south shores have been carried out, which, when finished, will leave an opening of about 700 yards at the ends, which curve seawards. Although one of these walls is not yet completed, the depth of water on the bar has been increased from 11ft. to 18ft. at low water spring tide, and is still deepening. On the Tyne, the two piers carried out at the mouth of the river have resulted in deepening the entrance from 6ft. at low water spring tide to 20ft.; the tonnage entering the port, both in quantity and size of the ships, has in consequence very largely increased. In 1863, 422 vessels over 500 tons register entered; in 1882, the number was 4827. In addition, the Tyne has become one of the most important harbours of refuge on the north-east coast, no less than 515 vessels bound for other ports having entered the harbour during gales in one year.

These are only a few of the examples which might be quoted to show that no physical impossibility exists to prevent the improvement of the harbour of the Mersey; and if public attention is directed to the matter, the meeting of Section G at Manchester will not have been without service to the commerce and trade of the district, which must be still further developed when the Ship Canal brings the ocean-borne goods into the heart of the city without breaking bulk.

TECHNICAL EDUCATION.

By Henry Dyer, C.E., M.A.

I have read the articles and letters on technical education which have recently appeared in The Engineer with mingled feelings of satisfaction and disappointment; for, although I think good service has been done in directing attention to some of the weak points connected with the present educational movement, some of the expressions used—both in the leading articles and the correspondence—will be apt to give to many readers the impression that the cry for improved technical—including commercial—education is got up and maintained chiefly by teachers and professors, largely for their own benefit. That this is not the case is clearly shown by the action of the Associated Chambers of Commerce at their recent meeting, when it was unanimously resolved, "That in consequence of the increasing competition with foreign countries, this Association should consider the whole subject of commercial and technical education, and support the Government in any practical legislation that will tend without loss of time to establish technical and commercial schools and evening classes, and that a committee of this Association be appointed to carry this into effect in conjunction with the Association for Promoting Technical and Commercial Education." The representatives at this meeting were, without exception, hard-headed men of business who were not likely to be carried away by mere sentiment; but, on the contrary, were likely rather to have gone to the opposite extreme, and looked upon education chiefly as a paying investment. There can be no doubt that with some men technical education is largely a craze, which, like other crazes, is apt to be run to death, unless controlled by an enlightened public opinion. During last session of Parliament a Technical Instruction Bill was introduced for England, while one was passed for Scotland. I have read carefully all the discussions which have taken place, both in and out of Parliament, and I have no hesitation in saying that neither the men who were the most active in promoting the latter Bill, nor the School Boards who will be responsible for its working, have clear ideas as to what they will do with it now that they have got it. The working classes, however, have rather decided opinions on the subject of taxation for education, and think that some general questions which underlie it should first have been decided. It would occupy too much space if I attempted to discuss these even in outline, but as the recent articles and correspondence seem to have had their origin in a leading article—Engineer, April 29th, 1887—on a paper which I read before the Institution of Engineers and Shipbuilders in Scotland, I should like to make a few observations on some of the points which have been raised.

In the article above mentioned it was said, "Let it not be supposed that we deprecate all technical instruction, and advocate a return to the old system of apprenticeship and no training. Very far from it. We desire to see university and technical school training altered and adapted to the purpose for which it is intended. It must be used to supplement shop training, not to supersede it. The weak point in university training is that it is all theoretical. The weak point in the old apprenticeship system was that it was all practical." With these remarks I thoroughly agree, and that being so, although we are likely to differ regarding details, and to the relative importance to be given to such details, these are matters for amicable discussion which I hope will be continued in the pages of The Engineer. With regard to the theoretical training which is given to engineers in universities and colleges, there can be no doubt but that a great deal of it is not only useless but unfits the students from becoming good practical engineers. The teachers seem to think that unless they glorify their subjects with the higher mathematics, and enter into calculations of probabilities of error which can only be ascertained by experiment, they are not worthy of a place in a technical curriculum. They seem to forget that nine-tenths of the work done by engineers requires nothing but elementary mathematics, and they go on dreaming about subjects which their students can never possibly apply, and which are useful neither for purposes of education nor instruction. The teachers ought to ponder the words of John Scott Russell on this point. He said, "For a mere philosopher, and for a practical mechanic, the science of physics must be taught in quite a different way. Certain elementary principles are no doubt the same for all men and all circumstances, but it is only the purest and most abstract science. To the man of science, the science itself is the end and aim; to the technical man, science is the mere tool and instrument, and what he wants to know is not the mere science only, but the means of shaping it to his end, and the best way of using it so as to achieve his purpose." Some years ago Professor Kennedy, in one of his introductory lectures, said, "I have no hesitation in saying that a man's knowledge of mathematics ends exactly where his ability to work problems ends; anything beyond that is useless, so far as his profession goes, and is even liable to have, in certain cases, disastrous consequences." No doubt some improvements have taken place during recent years, but in many cases the old-fashioned systems prevail.

On the other hand, the more popular education, namely, that given under the Science and Art Department, and the City and Guilds of London Institute, as at present constituted, is not likely to lead to very much good, for in too many cases the students are simply used as grant-earning machines, and their wants are less studied than the idiosyncrasies of the examiners. The consequence is that we have young men with bundles of certificates, who, when they find their way into a drawing-office, are practically useless. They have not been taught to think for themselves. They think and act according to a printed syllabus issued from South Kensington, or the text-book of their professor or examiner. The feeling is undoubtedly increasing among engineers that notwithstanding all that is being done in the name of education, the young men of the present day have not the same originality of mind as their predecessors. That is to say, they have not been educated at all. They have been turned out small editions of their teachers or examiners. As Professor Roscoe said in his presidential address at the British Association, "the country is now awakening to the necessity of placing its house in order in this respect, and is beginning to see that if she is to maintain her commercial and industrial supremacy, the education of her people from top to bottom must be carried out on new lines." The fundamental principle which must guide those who make the reorganisation is that science and practice must as far as possible go together, not only in the elementary, but also in the higher departments.

The great body of the people can never get beyond the elementary and the evening schools, compelled as they are to begin to earn their living at as early an age as possible. No attempt should be made to teach them their trade in such schools; all that should be given should be the elements of general education, and of the principles which underlie those trades. This should be done not merely from text-books, as is too much the case, but to a considerable extent by training the eye and hand to delineate, or to make, the objects about which instruction is given, all this being supplementary to practical work done in the workshop or manufactory. If the various trades would insist on those who wish to be admitted as journeymen producing evidence not only of having served an apprenticeship, but also of having obtained a certain minimum of theoretical instruction, we would soon hear the last of the cry about the decadence of our workmen. In some trades it might be necessary to have special schools for teaching some of the details of their work; but this must be done largely at the expense of those interested, and not of the public. On the Continent Chambers of Commerce and trades societies have done a good deal in this direction, and a beginning is being made in this country, as, for instance, in the work done by the Institute of British Carriage Manufacturers. I do not think it probable that the apprenticeship schools, supported by public funds, which are being instituted in France, are ever likely to find favour in this country.

Those who can afford to keep their sons at school till they are sixteen or so should send them to a secondary school, in which special attention is paid to the physical sciences, drawing, and a certain amount of training in the ordinary workshop tools, which will be useful to them whatever department of manufacturing industry they may take up. After a three years' apprenticeship, and study at evening classes, such youths would have received a fairly good introduction to theory and practice, and the best of them might take a session or two at the day classes of a college. It would be highly desirable if all students of engineering passed a year or two in the workshops before going to college, as such an arrangement would test whether they were at all likely to turn out good engineers, and their practical experience would be of the greatest assistance to them in their theoretical studies. There are, however, a comparatively large number of well-to-do youths who will prefer to go to college directly from the secondary school. If the instruction at the college is of the right kind, and if the students afterwards serve an apprenticeship of at least three years, they may turn out well, if their heart is really in their work, which unfortunately is too seldom the case.

Our present system of education tends largely to overstock the market with clerks, and with applicants for genteel occupation, and if we do not take care, with all this cry for technical education, we will turn out lots of men who are fair draughtsmen, but who will not condescend to a good day's work with the hammer and chisel, or who cannot do it even if they tried; while encouragement ought to be given to young men of energy and ability, by means of bursaries and scholarships, to pass from the workshop to the college: it must be done with great discretion, and only on the principle of helping those who are able and willing to help themselves. The most useful part of a man's education is not that which he gets at school or college, but that which he gives himself, when doing his best to overcome difficulties which may be placed in his way.

When I was in Japan I was so impressed with the necessity of a combination of theory and practice, that during the student's course I kept them six months of the year at college and six months at work. In the paper above alluded to, I pointed out that the arrangements of the Scotch Universities were well suited for carrying out this division of study and work, and I believe in some cases it is done. I understand that at Bristol a similar arrangement has recently been made with the students of University College.

I thoroughly agree with some of the remarks about the necessity for improved commercial education, only this, that I consider commercial education a branch of technical education. Many of the graduates of the continental technical schools, finding it impossible to obtain

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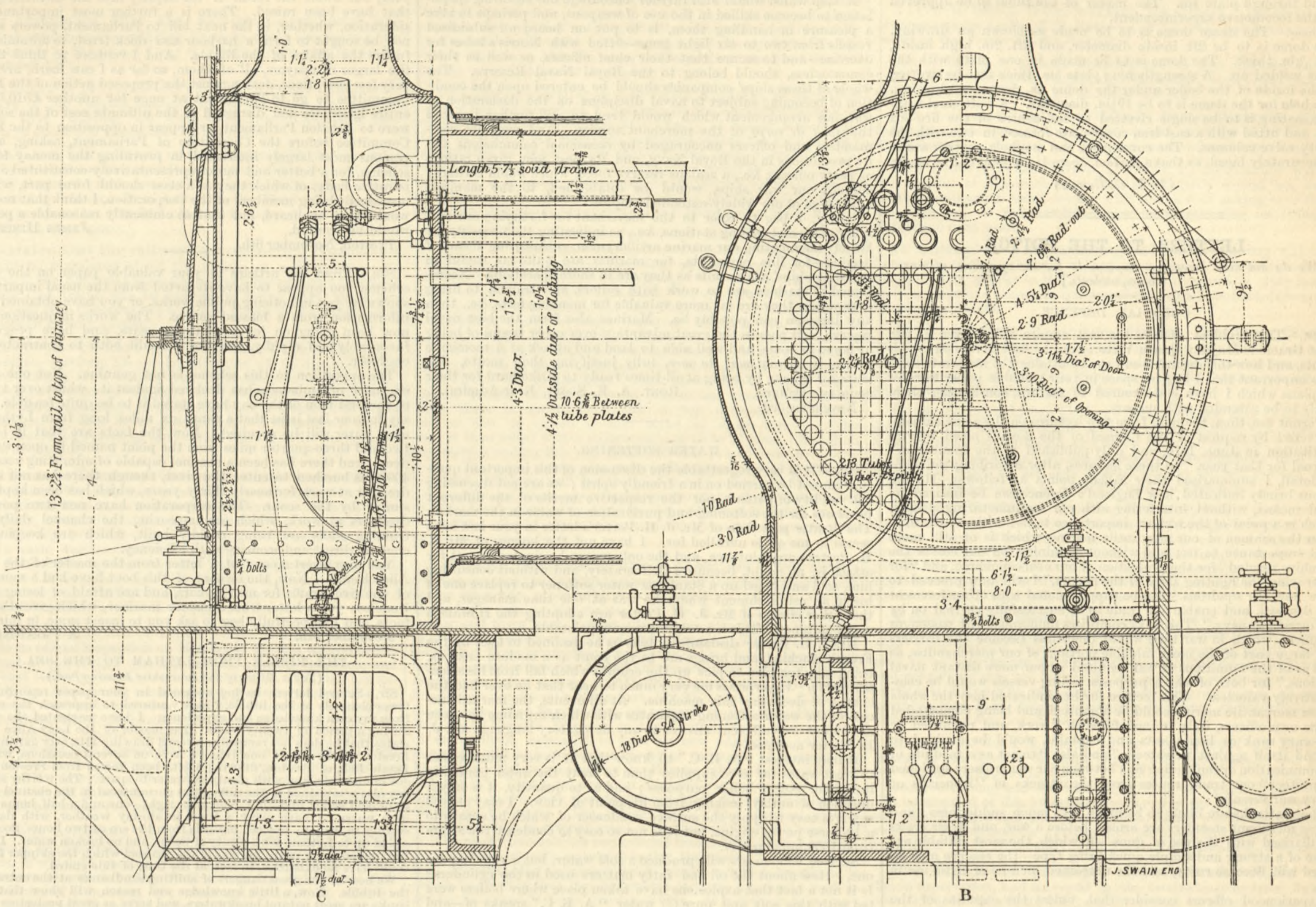


openings as engineers, have taken to the commercial side of the business, and they become excellent agents; while those who have been trained in the commercial schools proper are good linguists and sharp business men, and are certainly ousting Britons in all parts of the world, partly on account of their superior training, partly because they are willing to work for smaller remuneration, but largely because they exert themselves to adapt their goods to the wants of their customers. Notwithstanding all that has been said about German technical education, I believe that excellent general education is to be credited with a great deal of the recent commercial and industrial progress of Germany. Mr. Matthew Arnold, in his recent report, says that when visiting the German schools he was much struck with the superiority of the instruction over ours, and in his notes he often wrote, "The children are human." With us the children have been largely reduced to mere counters for grants, and when they leave school they have little independence of thought. I have also been struck with the excellence of the instruction in the German technical schools; it seems all chiefly designed to draw out the students, and not merely to pump information into them.

In one of the leading articles which appeared in THE ENGINEER, it is stated that "the sole purpose which any parent has in view when he makes his son an engineer is to enable him to earn his living. In other words, he wants to give the young man such a training, that he can, when trained, go and earn and make money;" while many of those who advocate improved technical education say that its chief object is to enable us to withstand continental competition. While recognising the necessity for attention being paid to these points, I think a great harm is likely to be done to the students if they are exclusively kept in view. The teachers should remember that the students are human, and that they have interests and duties far higher than the mere making of money themselves, or preventing the Germans from making more than their share of it.

LONDON AND SOUTH-WESTERN RAILWAY LOCOMOTIVE.

WE published as a supplement last week drawings of the London and South-Western Railway engine exhibited at Newcastle. We give above and on page 392 further drawings of the engine. The specification, written by Mr. W. Adams, locomotive superintendent of the line, to which the engine has been built, is so complete and well written that we give it in full, as a specimen of model English specification:—

Specification of Four-wheels Coupled Bogie Express Engines, London and South-Western Railway Company.

DRAWING NO. 4038.

Principal dimensions—

	ft.	in.
Inside diameter of cylinders	1	6
Stroke of piston	2	0
Length of boiler barrel between plates	10	2½
Diameter of boiler barrel outside	4	4
Length of fire-box shell outside	6	0
Width of fire-box shell at bottom	3	10½
Number of tubes	218	
Diameter of tubes outside	0	1¾
Height of centre of boiler from rails	7	4
Length of engine frame	28	11½
Thickness of engine frame	0	1⅛
Distance between frame	3	11½
Diameter of driving wheels on tread / Diameter of trailing wheels on tread } coupled	6	7
Diameter of bogie wheels on tread	3	4
Wheel base, total from front to hind wheels	21	11½
Centres of bogie wheels	7	0
Centre of bogie to centre of driving wheels	9	11½
Centre of driving to centre of trailing wheels	8	6
Height of centre of buffers from rails	3	5
Working steam pressure	160 lb. per sq. in.	

Preliminary remarks.—Where the dimensions are omitted in this specification they will be found fully detailed in the drawing, and these, as well as the terms of this specification, must be strictly adhered to, except in cases where the consent in writing of the locomotive superintendent has been first obtained.

Iron.—In all cases where the words "Best Yorkshire Iron" are specified the same must be wrought iron of the manufacture of Low Moor, Bowling, Cooper's, Taylor's, Monkbridge, or Farnley best iron. In all cases the brand of the manufacturer is to be kept where it can be seen.

Copper.—The copper is to be of best quality, and is to be supplied by either Williams, Foster and Co., the Broughton Copper Company, Pascoe, Grenfell and Sons, Vivian and Sons, John Bibby and Co., or other makers to be approved by the locomotive superintendent. The copper stays are to be made from best soft rolled bars, and the copper plates are to be properly annealed, and are to stand a test of being bent cold without showing any signs of cracking.

Brass.—The brass where specified must be of good tough metal.

Gun-metal.—The gun-metal for all the parts except the slide valves must be composed of copper, 8 parts; tin, 1 part. The gun-metal for the slide valves to consist of copper, 16 parts; tin, 2½ parts; zinc, ½. The axle boxes to be made of copper, 16 parts; tin, 2½ parts.

White metal.—The white metal must be composed of Babbitt's anti-friction metal.

Boiler barrel.—The boiler barrel is to be cylindrical and butt jointed, and is to be made in all respects as shown on drawing. It is to be 10ft. 2½in. long between the smoke-box tube plate and the throat plate of the fire-box shell, 4ft. 4in. outside diameter, and composed of ½in. plates of best Yorkshire iron. The longitudinal joints are to have inner and outer covering strips double rivetted; the rivets being placed zig-zag. The transverse joints are to have an exterior strip single rivetted. All studs and fittings are to be fixed before the boiler is tested. A soft steel mud-hole seating is to be rivetted to the bottom of the back plate of the boiler, and is to have a cast iron cover secured to it by studs. The boiler is to receive a coat of boiled oil whilst warm, and another coat of red lead before being lagged.

Smoke-box tube plate.—The smoke-box tube plate is to be of best Yorkshire iron ¾in. thick, the tops and sides of the plate being turned forward 2in., forming a flange for the smoke-box, and is to be secured to the boiler barrel by a continuous weldless ring of mild Siemens-Martin angle steel well annealed, manufactured by Vickers, Sons, and Co., Sheffield, or by Messrs. John Spencer and Sons, of Newcastle-on-Tyne, which ring must be faced, bored, and turned on the edges, and then shrunk on the boiler barrel, and is to be double rivetted to the same, the rivets being placed zig-zag. The tube plate is to be faced where it is joined to the boiler angle iron. Eight wash-out plugs are to be inserted in the plate as shown on drawing.

Fire-box casing.—The fire-box casing is to be 6ft. long and 3ft. 10½in. wide outside at the bottom, and is to be 5ft. 1in. below the centre line of the boiler. The top and sides are to be in one plate ½in. thick. The back plate to be $\frac{9}{16}$in. thick, and flanged over to join the covering plate. The front or throat plate is to be $\frac{9}{16}$in. thick, and flanged over to join the barrel. The seam joining of the fire-box shell and boiler barrel is to be single rivetted. The expansion brackets are to be rivetted to the sides of the fire-box-shell.

Rivets.—The boilers are to be rivetted with rivets ¾in. diameter] except those through the foundation ring, which are to be ⅞in. diameter well snapped; the holes in the plates are to be slightly countersunk under the rivet heads, and so punched that when the plates are in the proper position for rivetting, the smaller dimensions of the holes shall be together at the centre of the joint. All holes in the various plates and angle irons must be perfectly fair with one another, and must not be drifted in any case; should any of the holes not be perfectly fair they must be rimered out until they become so, and every hole must be completely filled by the rivet. The holes in the angle irons must be marked from the plates and drilled—not punched—the pitch of rivets and lap of joints being in all cases as shown on drawing. Great care must be taken that the plates are brought well together before any rivets are put in. The edges of all plates are to be planed before being put together. Any caulking which may be required must be done with a broad-faced tool, care being taken that the plates are not injured by so doing.

Inside fire-box.—The inside fire-box is to be of copper, 5ft. 2⅝in. long inside at the top, and 5ft. 4⅝in. long at the bottom; the height inside at the middle of the box is to be 5ft. 9½in., the width inside at the top 3ft. 6in. and at the bottom 3ft. 3¼in. The tube plate is to be ⅞in. thick where the tubes and barrel-stays pass through it; the remaining portion is to be reduced by hammering to ⅝in. thick, and is to be flanged back to join the covering plate. The back-plate, which must be ⅝in. thick, is to be flanged forward. The sides and top are to be in one plate and ⅝in. thick, the joints are to have 2¼in. lap when finished, and to be single rivetted with ¾in. iron rivets. All the joints in the copper fire-box are to be hand rivetted. Where rivets are applied, the instructions as regards the boiler rivetting are to be carried out. Two fusible plugs are to be fixed in the crown of the fire-box.

Fire-hole doors.—The ring for the fire-door is to be of the best Yorkshire iron, and is to be circular and of the dimensions shown on drawing. The ring is to be rivetted to the fire-box by ⅞in. rivets, and is to project ⅝in. beyond the edges of the plates, which must be well caulked. The fire-door is to be of wrought iron, formed in two halves and made to slide as shown on drawing. A wrought iron deflecting plate is to be fixed in the fire-hole door. Also a brick arch in the fire-box as shown. The outside and inside fire-boxes are to be stayed together on all sides with copper stays 1in. diameter, and fourteen threads per inch, screwed steam-tight into both copper and iron plates, and afterwards rivetted over, the thread being turned off the portion of the stay between the plates. Great care must be taken in cutting off the ends of the stays so as not to injure the threads. The pitch of the copper stays is not to exceed 4in. Great care must be taken that the holes in the outside and inside boxes are exactly opposite one another. The barrel stays are to be rivetted to the boiler with ¾in. rivets, and secured to the tube plate as shown on drawing. The inner copper fire-box is to have eight roof stay bars of best steel of the section shown, and secured to it by bolts which are tapped into the stays only as shown on drawing. The stays are to bear on the back and front plates, and are to be slung where shown to the outer shell. The back plate of the fire-box casing and the smoke-box tube plate are to be stayed together with thirteen longitudinal stays 1½in. diameter where they pass through the plates, and 1¼in. diameter for the remainder of their length; these stays are to have a head bedding on a copper washer and screwed into the fire-box plate, at the other end they are to be secured by a nut bedding on a copper washer on each side of the plate.

Tubes.—The boiler is to contain 218 lap-welded tubes, manufactured from steel. The weld is to be perfectly sound and well finished, the ends are to be clean and square, and the surface is to be free from defects. The tubes are to be No. 11 B.W.G., 1¾in.

outside diameter, expanded at the smoke-box end to $1\frac{7}{8}$in. outside diameter for a length of 3in., and contracted to $1\frac{5}{8}$in. outside diameter at the fire-box end. The tubes are to be expanded by a Dudgeon's tube expander, and beaded over at the fire-box end by a proper tube beader, and at the smoke-box end the tubes are to stand through plate $\frac{1}{4}$in. The maker of the tubes to be approved by the locomotive superintendent.

Dome.—The steam dome is to be made as shown on drawing. The dome is to be 2ft. inside diameter, and 2ft. 2in. high inside, and $\frac{9}{16}$in. thick. The dome is to be made in one plate with the seam welded up. A strengthening plate $\frac{1}{2}$in. thick is to be rivetted to the inside of the boiler under the dome as shown on drawing. The hole for the dome is to be $19\frac{1}{2}$in. diameter. A soft-steel manhole seating is to be single rivetted to the centre of the fire-box top, and fitted with a cast iron cover-plate formed in one with the safety valve columns. The cover-plate and manhole seating are to be accurately faced, so that a perfect steam-tight joint can be made.

(*To be continued.*)

LETTERS TO THE EDITOR.

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

COLONIAL DEFENCE.

SIR,—The problem of how the vast empire ruled over by her Most Gracious Majesty Queen Victoria can be best defended at all points, and how this desirable end can be attained at moderate cost, is so important that I beg for space in your valuable paper to refer to plans which I have endeavoured to mature, considering them likely to be attended with success.

Permit me, then, to quote from two lectures on the same subject, delivered by request of the Council of the Royal United Service Institution in June, 1876, and duly published in the Institution's journal for that year. In these lectures, after describing the plans in detail, I summarised their salient points as follows:—Having "thus briefly indicated how England's defence can be insured by local means, without interfering with our manufacturing people, which is a point of the utmost importance to us; without drawing upon the seamen of our mercantile marine, which is of still more vital importance to us; and without detaining on our coasts the warships needed" for the protection of our own commerce, and "for destroying the fighting ships of the enemy," I will now proceed to show how our sqadrons "can be supplemented with other forces at our disposal, and enable our trade to be successfully carried on by our merchant navy." This navy comprises numerous swift passenger steamers, which in war time would doubtless become the carriers of a large part of the most valuable portions of our merchandise, as well as of the munitions of war required at our more distant naval stations," for both of which purposes sailing vessels would be comparatively valueless. This lecture further indicated how the whole steam mercantile marine could be organised, and being commanded by its own officers, duly trained for such "work, and rewarded by honorary rank as lieutenants and captains, would be enabled to defend itself against privateers," and also "to act as a medium of communication or connecting link between our war cruisers stationed to protect" our trade routes from the attacks of "ironclads or heavy war vessels."

These attacks are likely to be made with much suddenness; and unless merchant steamers are armed before a war, and their crews familiarised with the use of guns—of which the most suitable are those of a strong and simple quick-firing type—the reserve men on board will become rusty, and the untrained men be of little use in war.

Experienced officers consider that, unless the captains of the merchant steamers in peace are enabled to retain command on the outbreak of war, their vessels are not likely to be of much assistance to the Royal Navy; and that the taking these steamers to England or elsewhere to have guns mounted, magazines fitted and filled, crew, provisions, and stores put on board, together with new captains and officers appointed who are wholly unaccustomed to such ships, is not likely to result advantageously.

There is likewise the liability to capture by any improvised war craft, whilst *en route* for their armament; and when at length armed—should the war still continue—they would be unfit for the thorough performance of the duties pertaining to our "Offensive Forces."

Our right arm, as General Collinson well expressed it at the Royal United Service Institution, is "the Navy;" and with this strong right arm, we must be ready to strike hard and quickly on the commencement of hostilities, and not wait at home to be struck by an enemy. The warships capable of striking hard are ironclads. These alone are suitable for efficiently protecting our valuable commerce; which more than one French statesman has spoken of crippling by means of French armourclads, rather than by following the old plan of sending their ships to fight similar vessels, in case of hostilities with us.

We have therefore to be prepared with cruisers capable of guarding our lines of communication, and sufficiently powerful to be a sure defence to our traders, which, if armed and sailing in pairs, should be enabled to brush off any improvised craft, and to continue their voyage, whether it be for the supply of the Royal squadrons with the men, coals, and provisions needed for their maintenance, or to carry British manufactures to our colonies and possessions, receiving in return the food and other necessaries required by the people of the United Kingdom.

The strong knife stems of the two companion trading steamers would be, if not a preventive to attack, at least a formidable means of defence; and if these weapons were supplemented by a torpedo or two, and a few quick-firing guns, it would enable the two vessels—handled by their skilful commanders—to conquer, so to speak, a safe passage to their destination.

Not only will powerful merchant steamers be required to maintain the fuel supply, which may be termed the life blood of the Royal Navy, but as quickness of sea carriage of merchandise would also be very important, especially on the outbreak of war, many more steamers would be wanted to take the place now occupied by sailing vessels. Some additional steamers would likewise be needed for hospital ships, and to carry the boats suitable for the conveyance of wounded men after an action, for the modern quick-firing guns will sweep the decks of all vessels not protected by side armour, and convert their gun decks into very shambles.

The Russian shell fire poured into the unfortunate Turkish ships off Sinope afforded an indication of what might even in those early days be anticipated, and serves to show how greatly the extension of the Red Cross to navies of all nations is now needed. Not only so, but the boats of war vessels could scarcely escape being riddled in a closely-contested struggle, and hence the sooner the Red Cross and its means for saving life are adopted the better it will be for sea-fighting humanity.

The subsidy recently voted by Parliament is both a retainer and also a great step towards the improvement of our mercantile marine, and the additional strength and safety which is secured by the stipulation for an increased number of water-tight compartments will be of much service in lessening the present heavy loss in ships and life. The terms which provide for the manning of these subsidised vessels by British seamen, and by preference men of the Royal Naval Reserve, will render the mercantile marine a more valuable factor in maritime defence; and the encouragement given for fulfilling the Admiralty stipulations will, amongst other advantages, tend to increase the popularity of the merchant service amongst British seamen. Such seamen will by their influence and example stimulate the coast population to enter *en masse* the Naval Volunteer force which Admiral Vesey Hamilton was fast raising for manning the gunboats and working the torpedoes and other weapons required for the defence of our harbours. These volunteers would be aided by our experienced coastguard men, who are stationed at every landing point around our shores, forming the nuclei of our coast defence force, and should, when supplied with machine guns and backed by our magnificent army of volunteers, render any attack either upon our dockyards and arsenals or upon any part of our shores "utterly hopeless."

A step which would still further encourage our seafaring population to become skilled in the use of weapons, and perhaps to take a pleasure in handling them, is to put on board all subsidised vessels from two to six light guns—fitted with Morris's tubes for exercise—and to secure that their chief officers, as well as their commanders, should belong to the Royal Naval Reserve. The whole of these ships' companies should be entered upon the condition of becoming subject to naval discipline on the declaration of war—an arrangement which would tend to still further improve the *esprit de corps* of the merchant service. And were its commanders and officers encouraged by occasional commissions and by promotions in the Royal Navy, and its best men given ratings as petty officers, &c., a zealous reserve force, which would cordially support our war ships, would be established, to the manifest advantage of our widely-extended empire.

Lastly, I beg to refer to the movement for fortifying our outlying ports and coaling stations, &c., as indicating the necessity for largely augmenting our marine artillerymen, substituting them—if needed—for line regiments, for marines are quite as useful in handling ships' armaments as they are in shore operations. Accustomed as marines are to work with sailors, and trained to firing over water, they are far more valuable for manning forts, &c., than any linesmen can possibly be. Marines also form the best naval reserve, and possess the great advantage over other troops of being at home in boats, and well able to land and attack at a moment's notice, free from *mal du mer*, fully justifying their motto, *Per mare per terram*, by being at all times ready to strike hard for their country's welfare. ROBT. A. E. SCOTT, Rear-Admiral.

November 3rd.

WATER SOFTENING.

SIR,—It is very regrettable the discussion of this important question cannot be carried on in a friendly spirit; we are not discussing the validity of patents, nor the respective merits of the different processes for the softening and purification of water in the market. The greater part then of Mr. J. H. Porter's letter in your last issue seems to me quite uncalled for. I have not the honour of Mr. J. H. Porter's acquaintance, and the only reason he singles me out for attack is, no doubt, because I deliberately, and without consulting him, sold and fitted up a Stanhope water softener to replace one of his in an establishment where he was at one time manager, and that other clients of Mr. J. H. Porter are adopting the Howatson water-softener. This is no doubt very unpalatable.

Mr. J. H. Porter disdainfully tells us he declined to take up the French machine, and brings me to the front as a modern Lazarus, being only too glad to pick up the crumbs which fall from his scientific table. It surprises me very much to hear that he ever had the chance of declining this machine. At all events, the marked success of the water-softening apparatus with which my name has been associated is a sufficient answer to any derogatory language Mr. J. H. Porter may use.

It may interest "A. B. C." to know that it is very much easier to treat water for town supplies than to treat the water generally in use for steam boiler purposes; and as to quantity, it is only a question of outlay, looking from his point of view. I may as well say it is easy to apply the surface condenser of which he speaks to a 10-horse power engine, but it is not so easy to condense the steam from 1000-horse power.

Surface condensers will produce a soft water, but a very impure one. How about the oil and fatty matters used in the cylinders? Is it not a fact that explosions have taken place where boilers were fed with this soft and pure (?) water "A. B. C." speaks of—and how about the incrustation on the condensers?

ANDREW HOWATSON.

Cronberry, Belle Vue-road, Upper Tooting, S.W., November 7th.

SIR,—Having reference to the correspondence respecting the above, we think Mr. J. H. Porter, in the 4th inst., purposely goes out of his way in bringing up issues which had not previously been touched upon. He takes exception to one sentence at the head of our prospectus, which reads thus:—"This apparatus is quite distinct from any other, and being of the most recent date, supersedes other previous and similar inventions." This, as he must be aware, was not intended to convey the construction he puts upon it, but had reference to previous patents of the inventor. It is certain, however, that so far as we were concerned, the words even if used as he suggests would not be inapplicable, as, with a knowledge of all the various machines in use, we arranged to purchase the "Howatson" for a considerable sum, and are happy to say the results are highly satisfactory to us, a fact of which Mr. Porter is probably aware from various circumstances which must have come to his knowledge, and assured him that he at any rate is not able to convince others that the "Howatson" is only composed of the tanks, &c., he takes such great care to particularise, and to endeavour to hold up to ridicule, but which he subsequently claims as adopted from his earlier designs. This assertion we must ask your readers to accept for what it is worth; for ourselves, we are quite innocent of such a thing as taking advantage of any of Mr. Porter's modes of treatment, which, as a whole we cannot approve of. He only goes into one part of the machine, and not into those more essential portions which are the cause of its success. The machine is quite open to inspection at all times, and its value may be judged by those who wish to test it, while for a full description your readers cannot do better than refer to a notice of the same in your impression of the 21st May, 1886.

Referring to the concluding paragraph, wherein Mr. Porter is good enough to inform us who is our patent agent, his assertion is as incorrect and misleading as the other portion of his letter.

We may inform your correspondent "A. B. C." that we shall be happy to undertake the treatment of water for town supplies in any quantity, and it may probaby surprise him to know that we are now arranging for treating a million or more gallons a day, in several instances, for the use of boilers and manufacturing purposes only. J. W. GRAY AND SON.

115, Leadenhall-street, E.C., November 8th.

THE RIVER RIBBLE SCHEME

SIR,—I trust that you may continue to notice, as occasion may bring forth, the further developments of this scheme, professionally interesting as these must be to the engineering world, and fraught with issues so financially serious to a not over-prosperous provincial town.

It does not yet appear to be fully perceived, locally, that the *crux* of this question, and, indeed, of the entire series of questions connected with it, lies in the present personal constitution of the Ribble Committee. Change or modify that, and all the rest will follow, *e.g.* (1) The selection of a consulting engineer, really independent of the views of either party, and the proper framing and definition of his instructions. (2) The fixing of the correct and sufficient amount of the further borrowing powers required to complete the scheme, in any future application to Parliament.

There is not the least reason to rush the appointment of an independent engineer. We can afford not only time sufficient to make a wise selection, but can give him ample time to investigate everything for himself, to verify every estimate put before him, to look with his own eyes upon the actual situation, and to judge with his own mind, after he has assured himself that he has got all the requisite data correctly before him. The present dredging works, with those comprised within the existing contracts for dock works, &c., will be going on all the time, should it take six months or more to consider and frame his report. We have £140,000 unexpended of our present borrowing powers, which will carry us on at the present rate of progress for another twelve months. Not the least harm or inconvenience, therefore, will accrue should the ratepayers by their forthcoming vote decide not to go to Parliament at all this year, but await the result of the inquiry into the essential points that have been raised. There is a further most important consideration, whether, in the next bill to Parliament, powers should not be sought to form a harbour and dock trust, to administer in future the affairs of the Ribble. And I venture to think that if the larger ratepayers, all of whom, so far as I can learn, are, with very few exceptions, dead against the proposed action of the Ribble Committee to go to Parliament at once for another £510,000 in entire ignorance and disregard of the ultimate cost of the scheme, were to petition Parliament, or appear in opposition to the Ribble Committee before the Committee of Parliament, asking, as the persons most largely interested in providing the money for the scheme, for a better and more representatively-constituted administrative body, of which they as a class should form part, without necessarily being members of the Corporation, I think that not only would they be heard, but that so eminently reasonable a petition would be granted. JAMES HIBBERT.

Preston, November 6th.

SIR,—From the articles in your valuable paper on the above scheme you appear to have departed from the usual impartiality shown by you in noticing public works, or you have obtained your information from a biassed source. The works in question have now been going on for over three years, and have progressed favourably and rapidly, and are a credit both to contractor and engineer.

The opposition to this scheme is not genuine. Not one single engineer of eminence has declared against it; whilst over twenty of the first men of the day have stated it to be quite feasible. You say in your last issue that a canal six miles long from Lytham to open water will be required. Now, the facts are that it is only two and three-quarter miles from the point named to open water—deep—and there has been a channel capable of admitting vessels of 400 tons burthen to enter the river, though there has not been a dredger at work for nearly thirty years, which has been kept open simply by the scour. The corporation have now two powerful dredgers at work, which are improving the channel daily, and training walls are being rapidly built, which are keeping the channel direct and scouring with efficiency.

You also insert a copy of a letter from the master of the Lady Alice Kenlis. Now, the owners of this boat have had a monopoly of the river traffic for many years, and are afraid of losing same. I enclose you a letter from a master mariner, which gives the true facts, and I respectfully beg to ask you to insert same, in fair play.

November 9th. A PRESTONIAN.

THE RIBBLE FROM LYTHAM TO THE SEA.

(*To the Editor of the Lancashire Evening Post.*)

Sir,—Several letters having appeared in your paper regarding the lower channels of the Ribble, I have ventured to approach the subject from my own knowledge and experience. I have navigated the Ribble during a period of twenty years. The master of the Lady Alice Kenlis states that he does not remember a vessel drawing 11ft. ever getting from Preston to the sea in one tide. I have on several occasions, with the Bessie Bell, of Preston, drawing $11\frac{1}{2}$ft., been towed from Preston to the sea in one tide, and with plenty of water to spare. The worthy skipper has also complained of the difficulties encountered in the channel owing to broken water, and—if I remember right—one and a-half hours before high water. I have many a time, in stormy weather, with darkness setting in, had to proceed inwards from the sea at two hours' flood, and sailed up to Lytham with plenty of water, and no broken water. Indeed, the broken water in the fairway of the channel which the skipper fancied could have no existence, in fact, at the time of tide stated.

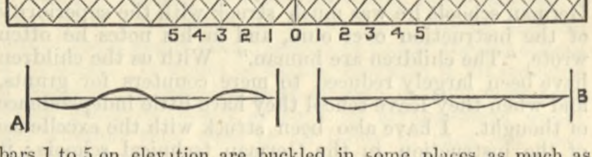
We hear of the great dangers of shifting sandbanks at the entrance to the Ribble. Now, a little knowledge and reason will show that these banks are great natural breakwaters, and serve as great protectors to the channels, as, once inside the banks, the mariner's position is comfortable, and navigation deprived of its difficulties.

I can vouch that there is all the water which appears in the engineer's reports; and, moreover, it is a broad and capacious channel, in which vessels of considerable burthen can beat to windward, making good tacks each way. I have not the slightest doubt that when the river is dredged above, ships of 20ft. draught and upwards will use this noble and spacious waterway with the greatest facility.

Freckleton, November 5th. W. C. HANKINSON, Master Mariner.

A DEFECTIVE BRIDGE.

SIR,—Your correspondent has mistaken the bracing in the bridge; there is only one vertical member in the entire span besides the ends, and that is at the centre, as shown in enclosed sketch. The buckled parts assume the shape illustrated in the sections A and B, and the



bars 1 to 5 on elevation are buckled in some places as much as 3in. The bridge was designed, so I understand, with a camber of 9in., and during its erection the bars were as much buckled then as they are now. INQUIRER.

November 7th.

CONTINUOUS BRAKES.

SIR,—In your issue of 28th October, page 347, I gave a statement based upon the Board of Trade returns showing the number of vehicles which are fitted with two complete brakes. From those figures it will be seen that the Westinghouse brake is common to 982 of the 995 vehicles. Mr. G. Mitchell, page 371, states "it cannot be denied that vehicles have been fitted with the two brakes as described by Mr. Stretton," but he goes on to inform your readers that the three leading lines to the north, namely, the London and North-Western, Midland, and Great Northern, have "a complete agreement, as evidenced by their stock being equipped with *the* vacuum brake." Will Mr. Mitchell inform me to what he refers when he speaks of *the* vacuum brake? Upon a recent occasion I had to examine all the various brakes on behalf of a railway servants' society. I found simple vacuum brakes with double pipes, simple vacuum brakes with single pipes, automatic vacuum brakes which "leak off" in two minutes, automatic vacuum brakes which do not leak off. A Midland vehicle cannot be worked in a North-Western or Great Northern train, neither on the other hand can a brake on a Great Northern or North-Western vehicle be used in a Midland train, if that is "a complete agreement," I must leave the subject to your readers for their own consideration, and probably Mr. Mitchell will oblige by stating which of the various vacuum systems in use is the particular one to which he refers. I hope and trust the one is not the one in use at Hexthorpe.

17, Mill-hill, Leeds, November 8th. CLEMENT E. STRETTON.

ACCIDENTS ON INDIAN RAILWAYS.—The returns of accidents on Indian Railways during the first quarter of the year 1887 show that on an open mileage of 13,002 miles, with a train mileage of 11,765,517 miles, the total number of persons killed was 83, and of those injured 185. Of the number killed, however, 41 deaths occurred amongst persons unconnected with the railways either as passengers or as servants, of which 4 were due to accidents at level crossings, 34 due to persons trespassing on the lines and persons committing suicide, and 3 to unexplained causes.

RAILWAY MATTERS.

The Manchester Jubilee Exhibition at Old Trafford, to which there have been above four and a-half millions of admission since the opening in May, was finally closed on Thursday afternoon.

It is announced that the Servian Government has concluded arrangements with the Porte by which the railway line from Belgrade to Salonica, by way of Vranja, will be open for traffic on December 15th.

A railway is projected between Dixon and Charleroi, the centre of the Belgian coalfield, by Bar-sur-Aube, Rocroy, and Chimay, thus reducing the distance between Marseilles and Antwerp to about 360 kilometres, or 224 miles.

Trials are being made in the States with an electromotive in which the motor spindle is coupled direct to the driving wheels by means of crank arms on the motor spindle and side rods to the driving wheels. It is known as the Field electromotive, and it appears to be the first attempt to drive direct and use a motor of such slow speed.

It is stated that the railway line connecting Sophia and Pirot will be completed about the middle of next month. M. Neilkovitch, the Bulgarian diplomatic agent, has officially informed the Porte that traffic will be opened in March next, when the Turkish lines and Constantinople will be placed in connection with the European railway system.

In the course of Lord Dufferin's tour to visit the principal frontier stations, his special attention will be directed to an improved scheme for a railway from Kurrachee to Upper India, either by a narrow-gauge line between Hyderabad and Pachpadra, or by a broad-gauge across Rajpootana direct to Delhi. The *Times* correspondent says the latter plan would, it is understood, enable Indian wheat to be placed in the London market at 1s. per quarter less than at present.

The Brussels Tramway Company, which works all the omnibus lines in the Belgian capital, has now definitely abandoned the original and time-honoured form of omnibus, for a vehicle with low platform, resembling a tramcar, with twelve places inside and nine on the top, but with standing room for seven persons in the rear. In warm weather open vehicles like summer tramcars are used. At first the springs were not sufficiently yielding, so that there seemed to be none; now the sensation experienced in going over the paving setts is that the springs are a little too yielding; but it must be difficult to hit the happy medium.

Acting for the Board of Trade, Major-General Hutchinson made an official inspection on Monday of the first section of the Oxted and Groombridge new line of the London, Brighton, and South Coast Railway from Oxtend to Edenbridge. He was accompanied by Mr. Allen Sarle, secretary and general manager, Mr. F. D. Banister, resident engineer, Mr. W. Stroudley, locomotive superintendent, Mr. J. Richardson, traffic superintendent, and Mr. G. W. Staniforth, goods manager. Major-General Hutchinson expressed himself well pleased with the new works, which had been carried out under the supervision of Mr. George Lopes, under the direction of Mr. Banister. The contractors, Messrs. Firbank, were represented by Mr. Stennett. It is understood that this section of the line will be opened for traffic on January 1st next.

The train accidents in America in September include 83 collisions, 63 derailments, and 4 other accidents—a total of 150 accidents, in which 61 persons were killed and 191 injured. These accidents are classified by the *Railroad Gazette* as follows:—Collisions: Rear, 37; butting, 43; crossing, 3; total, 83. Derailments: Broken rail, 2; spread rails, 1; defective switch, 3; broken frog, 1; broken bridge, 2; bad track, 2; broken wheel, 5; broken axle, 6; fall of brake beam, 1; broken truck, 2; failure of brakes, 2; misplaced switch, 6; runaway train, 1; bad switching, 2; open draw, 1; cattle on track, 3; washout, 1; accidental obstruction, 4; malicious obstruction, 2; sleepers burned by forest fire, 1; unexplained, 15; total, 63. Other accidents: Car burned while running, 1; broken connecting-rod, 1; boiler explosion, 1; others, 1; total, 4. Total number of accidents, 150.

In his report on the accident that occurred on the Belfast and Northern Counties Railway on September 28th, when the passenger train, which is timed to leave and left Londonderry at seven a.m., ran off the rails just before it reached the bridge over the river Bann, Col. F. H. Rich recommends, "That the check-rail on the Bann river bridge be altered and placed not more than 1¾in. from the inside rail of the curve, and that it be extended at each side of the bridge for a short distance beyond the thirteen and eleven chain curves." He also says:—"As the bridge has no solid parapet, I recommend that guide baulks, shod with iron, 4in. or 5in. higher than the rail, should be fixed on the platform of the bridge, on the outside of the rails, so that if any vehicle leaves the rails it may be prevented from running into the river. The bridge should be provided with distant as well as stop signals. The automatic vacuum brake did good service in pulling up the train in about 50 to 70 yards after it was applied, in keeping the vehicles in line, and preventing those at the tail of the train from overrunning those in front. It probably prevented the train from running into the river."

The first electric mine railway in America is described in the American *Electrical World* of the 22nd ult., which thinks it is "fittingly the longest of its kind in the world. Considering the ease with which the electric railway can be applied, especially in coal mines, where the item of fuel cost does not enter into the problem, it is somewhat strange that no work of this character has been done before. But the results obtained in the first attempts leave little doubt that it is now only a question of time when every large coal mine at least will have its electric road. On a recent visit which we made to the great Lykens Valley mines we had an opportunity of witnessing this road in operation, and its performance was, we are free to state, a most satisfactory one. A direct proof of this can be found in the fact that since our visit the road has been extended a distance of a quarter of a mile." In the case illustrated the Schlesinger motors are used, and motion is conveyed by a link chain from a secondary spindle on the motor frame to a third motion shaft between the driving wheels, and through which the latter are driven. The road is 6300ft.; gradients only about 1 in 20. A 25 lb. rail fixed to posts forms the conductor and the track rails the return.

Writing upon the Bulgarian Railway, the *Times* Sofia correspondent on the 6th inst., says:—"Disregarding a fine rain which was falling, almost the whole population of Sofia, men, women, and children, went out this morning to witness the arrival of the first locomotive from Vacarel. At 10 o'clock precisely the expected train, filled with workmen and peasants and loaded with material, signalled its approach by a prolonged whistle, which prompted the large crowd gathered in and about the station to burst forth into enthusiastic hurrahs, and while the cheering still continued the train steamed into the station. Subsequently a banquet given by the railway company in honour of the event took place, at which covers were laid for about 500 persons. No member of the diplomatic body was present, although invitations had been sent to all the agencies. Prince Ferdinand, speaking in Bulgarian, proposed the toast of "The Prosperity of the First Bulgarian Railway Construction Company," expressing the hope that the line would soon be completely finished. To this toast M. Groseff, the director of the company, replied, stating that with the arrival of his Highness the Prince new courage and a fresh impulse had been given to the company to persevere in their efforts to effect the junction of the railway with the European system.

NOTES AND MEMORANDA.

A recent number of the *Comptes Rendus* contains a paper on "Researches on Drainage," by M. Berthelot. Numerous experiments made at Meudon in connection with the study of nitrogen in vegetable soil led to the general conclusion that the drainage of rain-water carries off a much larger quantity of nitrogen than that supplied to the soil by the atmosphere, and especially by the rain-water itself. This result is, it is thought, destined to modify the views hitherto accepted regarding the conditions of natural vegetation and of husbandry.

At a recent meeting of the Paris Academy of Sciences a paper was read entitled, "Remarks on the Physical Principle on which is based M. Clausius's New Theory of Steam Motors," by M. G. A. Hirn. The view here contested is that the cylinder may be regarded as impermeable to heat, and consequently that the exchange of heat between its walls and the steam at each stroke of the piston is a factor which may be neglected by the practical mechanician. M. Hirn claims that most English and American engineers have adopted his views in the "Hirn-Zeuner controversy."

Of the Chicago street pavement the *Tribune* of that town says:—"Macadam ranks next above cedar blocks in cost as street pavement. Were the macadam pavement seen in Chicago not bound to be very dusty when dry and very muddy when wet it would be an almost ideal pavement. In macadamising a street there is first spread in the road-bed, 15in. below the future surface of the street, a layer of large limestone in pieces 6in. to 12in. in diameter. This limestone is obtained from city quarries and is bought by the cord, 13,000 lb. making a cord. On top of the first layer of stone is placed another layer of a smaller size, usually from 1in. to 3in. in diameter. Then above this is placed a still smaller grade, the stones being about the size of chestnuts. Then there is spread over this a top dressing of granite, and on this is spread a thin layer of Joliet gravel. The road is then rolled with a roller weighing 15 to 20 tons. Macadam pavement is costing this year from 1.50 dols. to 1.80 dols. per square yard. There was nearly one and a-half miles of it laid in Chicago last year, and there will be two and a-half miles laid this year. January 1st last there was about twenty-eight and a-quarter miles of macadam pavement in Chicago, four-fifths of it being on the West Side. Ranking next above macadam in cost comes asphalte pavement in sheet form."

For some inexplicable reason there are a few people will not see that the English foot measure is as good a measure and better than any other arbitrary standard. "A Plea for the Metre" was read at Manchester by a Mr. E. G. Ravenstein. The author said there were "great advantages attaching to the metre as a universal international standard of length. There were at present in use three international measures of length, viz., the English foot, in countries covering 18,188,112 square miles, with 471,000,000 inhabitants; the metre, 12,671,200 square miles, 347,091,000 inhabitants; and the Castilian foot, 752,901 square miles, 5,905,000 inhabitants. The English foot, at present in use throughout the British and Russian Empires, in the United States, and in some other countries, appeared to gain no new adherents, while the metre was still engaged upon a career of conquest. Denmark and Russia were the only countries in Europe which had not as yet adopted it." This is not true, for England has not adopted it, and there is no reason why she should not stick to her foot and let others do the same. The author said, "The metrical system appeared to him to present great advantages to business men, and in 1885 nearly one-half the commercial transactions of the country were carried on with countries using the metre." This may be true, but the other countries would prefer our foot length, as is shown by the fact that the half-metre is most commonly used in ordinary life, and half and quarter of this. It is difficult to see any truth in the statements that, "To geographers and statisticians the universal acceptance of the metre would prove an immense boon. Scientific men in other departments had freely adopted the metre, and geographers should follow this laudable example." That would not equally apply to the yard. Owing, however, to the intimate connection of geography with the common affairs of life, the author despaired of the general acceptance of the metre until it should have become the legal standard of length.

Speaking of the future of the special steels, the *Engineering and Mining Journal* says: "Chrome steel appears to lie between carbon and manganese steels on the one hand and tungsten steel on the other. More costly, harder and less easily forged than the former, it is cheaper, when hot more forgeable, and when cold more ductile and less hard than the latter; manganese steel, however, excels it in toughness. Three natural fields suggest themselves for chrome steel. First, where extreme hardness is needed and where tungsten and manganese steels are excluded by the difficulty of forging them, as in the case of cutting tools and abrasion resisting pieces of complex form. Second, where extreme hardness must be coupled with fair resistance to shock, as in the case of armour-piercing projectiles; here tungsten steel appears to be excluded by its brittleness and badly handicapped by its cost; but manganese steel, incomparably tougher and but slightly softer than hardened chrome steel, may offer it serious competition, while some tungsten manganese steel, borrowing extreme hardness from tungsten and toughness from manganese, may prove a yet more formidable competitor. The combined hardness and toughness of manganese steel should pre-eminently fit it for armour-plate. Thirdly, where extreme hardness in the finished piece or in some portion of it must be combined with the power of being toughened or softened by annealing, as in the case of pieces which must be machined or engraved, or of which one part must be very hard and another very tough. Here the fact that tungsten and manganese steels can be but slightly softened by annealing appears to exclude them. It is very doubtful whether the tensile strength of chrome and tungsten steels, high as it often is, is greater than that attainable in carbon steel; and, as the latter for given tensile strength is certainly less treacherous and brittle than tungsten steel, and probably both more uniform in composition and more homogeneous than chrome steel, the employment of these special steels, where tensile strength alone or chiefly is sought, is hardly to be expected."

A paper on the magnetisation of Hadfield's manganese steel in strong fields was read at the recent British Association meeting by Professor J. A. Ewing, F.R.S., and Mr. William Low. Messrs. Hadfield, of Sheffield, manufacture a steel containing about 12 per cent. of manganese and 0·8 per cent. of carbon, which possesses many remarkable qualities. Prominent amongst these, as the experiments of Hopkinson, Bottomley, and Barrett have shown, is a singular absence of magnetic susceptibility. Hopkinson, by applying a magnetic force, H, of 244 C.G.S. units to a specimen of this metal produced a magnetic induction, B, of only 310 C.G.S. units—in other words, the permeability μ was 1·27, and the intensity of magnetisation I was a little over 5 units. The experiments made it clear that even under magnetic forces extending to 10,000 C.G.S. units the resistance which this manganese steel offers to being magnetised suffers no breakdown in any way comparable to that which occurs in wrought iron, cast iron, or ordinary steel at a very early stage in the magnetising process. On the contrary, the permeability is approximately constant under large and small forces. The conclusion has some practical interest. It has been suggested that this steel should be used for the bed plates of dynamos, and in other situations where a metal is wanted that will not divert the lines of induction from neighbouring spaces. In such cases the magnetic forces to which manganese steel would be subjected would certainly lie below the limit to which the force has been raised in these experiments. We may therefore conclude that in these uses of the material it may be counted upon to exhibit a magnetic permeability only fractionally greater than that of copper, or brass, or air.

MISCELLANEA.

The sanitary authorities of Tuam have adopted plans submitted by Mr. Mulvaney, of Castlerea, for new waterworks, estimated to cost £7000.

"How to Select Wood-working Machinery" is the title of some articles by Mr. J. T. Ransome, of Chelsea, now being published in the *Timber Trades Journal*.

An exhibition of coke-burning stoves was opened last week by the Brussels Municipal Authorities, and twenty-nine prizes were awarded among a hundred exhibits.

We understand that her Majesty has contributed £25 to the Lees fund, to which we referred last week (p. 377), and of which further particulars will be found in our advertising columns.

The American Exhibition, Limited, in accordance with the Articles of Association, is to be voluntarily wound up, and another company is being formed with the view of taking over the buildings, &c., of the late Exhibition, and organising an Italian Exhibition next year.

It is stated that the soundings which are being taken in the lake at Zug give rise to apprehensions of a further subsidence of land, similar to the disaster which occurred in July last, and the houses of the shore quarter of the town have been deserted by the inhabitants.

At the Adelaide Exhibition Messrs. Ransomes, Sims, and Jefferies, of Ipswich, have been awarded the first order of merit for their exhibits, which include portable steam engine, vertical engine and boiler, single and double furrow ploughs, patent chilled ploughshares, and horse rakes.

In the Graefin Laura Colliery blast furnace slag is being used for filling the goaves, and a great saving is the result, partly from the extra coal obtained, and partly from the saving in ground occupied by slag heaps. A full account of the methods used is given in a paper in the July journal of the British Society of Mining Students by Mr. C. Z. Bunning, A.M. Inst. C.E.

Messrs. W. Simons and Co., Renfrew, have just contracted to build a fast steel screw steamer for passenger service on the Mediterranean. The vessel is to have saloon accommodation for first and second-class passengers, and electric light is to be employed for lighting the various cabins, engine-room, &c. The engines are to be of the triple expansion type, and will be made by the builders. A high rate of speed is intended.

Messrs. Laird Bros., of Birkenhead, have been selected by the Hamburg American Company to build for their Hamburg and New York Express Passenger Service a steamer of nearly 7000 tons, to be constructed of steel with a complete double bottom, and subdivided into not less than ten principal water-tight compartments, fitted with twin screw engines of great power, all the arrangements being made to secure a maximum of security and comfort in conveyance of passengers.

A graving dock is about to be constructed at Barry Island, in the West of England, which, when completed, will be one of the largest in the world. It will be capable of taking in vessels 700ft. long, and will hold 62,000 tons of water. The dock will be emptied of this immense quantity of water in four hours by one pair of centrifugal pumping engines. They will be the largest ever used in England for graving dock purposes, and will be made by Messrs. W. H. Allen and Co., of York-street, Lambeth, London.

The number of passenger steamers under Board of Trade supervision, and surveyed in the twelve months from July 26th, 1886, to July 25th, 1887, and in respect of which passenger certificates had been issued, was 1964. Out of all the number under survey during ten years only eleven explosions have occurred. In 1879, 1880, 1884, and 1886 there was not one, and the highest total for any single year was four in 1883. There were two in 1887—one through deterioration or corrosion, and one through shortness of water; and the same number in 1878—one from deterioration, &c., and the other through defective construction. In 1881 there was but one explosion, and that is ranged under the general heading of "miscellaneous" causes.

The following letter concerning the Panama Canal has been sent by M. Victor de Lesseps, who signs "Pour le Président Director," that is to say, for M. Ferdinand de Lesseps, to the editor of the *Messager de Paris*:—"Paris, 4th November, 1887.—Monsieur, —In reply to the questions contained in your letter of 3rd inst., I have the honour to inform you: First—That M. de Lesseps will keep his promise, and will very shortly go to Panama. Second—That the canal will be pierced about the month of February, 1889, but that it will not be officially inaugurated till February, 1890, when it will be navigable for large vessels. From the month of March, 1889, to that of December of that year, ships drawing six metres of water will be able to pass through the canal. Third—The present resources of the company are sufficient for the termination of the projected works, therefore a new loan will not be contracted. Fourth—The January coupon of the shares will be paid. Make what use of my letter you may judge proper to re-assure those interested in the enterprise, and who feel unjustified alarm at the exaggerated fall in the price of Panama Securities."

The long expected debate on the repeating rifle question took place on Tuesday, in the Army Committee of the Hungarian Delegation. Count Tisza, brother of the Hungarian Premier, asked what were the motives for the change from the eleven millimetre to the eight millimetre calibre; to what use the large calibred rifles already finished were to be put, and whether there would be any trial of other systems than the Mannlicher. In reply, the War Minister gave a long and detailed explanation that occupied nearly two hours in delivery. He declared emphatically that there was no better system in existence than that of Herr Manlicher, and it had therefore been adopted for the smaller bore as well as for the larger earlier pattern. Contrary to general belief, the small calibred rifle will not be of lighter weight than the larger bore, as the barrel requires to be stronger, while the extra weight arising from the larger quantity of cartridges carried will be balanced by the new light equipment. The committee then passed the vote for the new rifles, the opposition collapsing on the concession being made that upwards of a quarter of a million of the new weapons shall be manufactured in Hungary.

An international exhibition is to be held at Brussels from May to October next year, and the ground allocated for the purpose is the ancient Champ de Mars, covering a space of nearly 100 acres. The permanent buildings are very fine, and will be supplemented by temporary buildings of brick, iron, and glass, to meet the requirements of exhibitors. The gardens are beautifully laid out, and no pains will be spared to make the exhibition attractive, instructive, and profitable alike to visitors and exhibitors. A special arrangement of an exceptionally favourable character has been made with regard te the British Empire section, which will occupy a position in the best portion of the grounds. It is desired to illustrate, as fully as the space will admit, the vast resources of the British Empire, particular regard being had to those products and manufactures which are most suitable for the Belgian market. The charge for space is rather higher than is usual at English exhibitions, but is only about one-half the amount prevailing in the other sections of the Brussels Exhibition. In addition to gold, silver, and bronze medals, exceptional inducements are offered to exhibitors, a sum of 500,000f. having been set aside for distribution in special prizes. Mr. S. Lee Bapty has been appointed by the Executive of the exhibition to be commissioner-general for the British section.

EXPANDING MANDRIL.

MESSRS. H. B. BARLOW AND CO. MANCHESTER, ENGINEERS.

Fig. 2

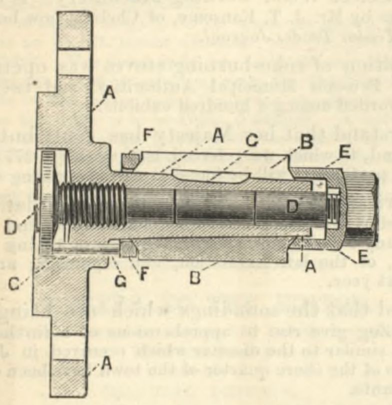


Fig. 1

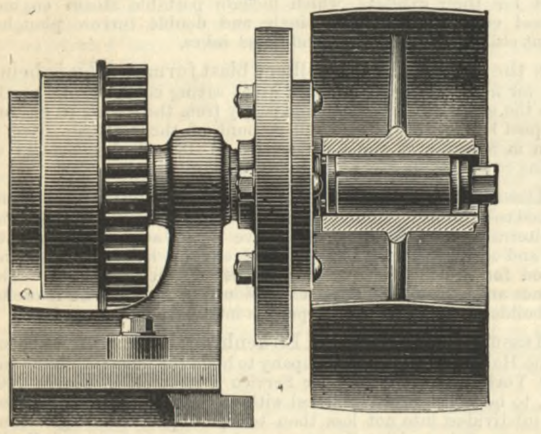
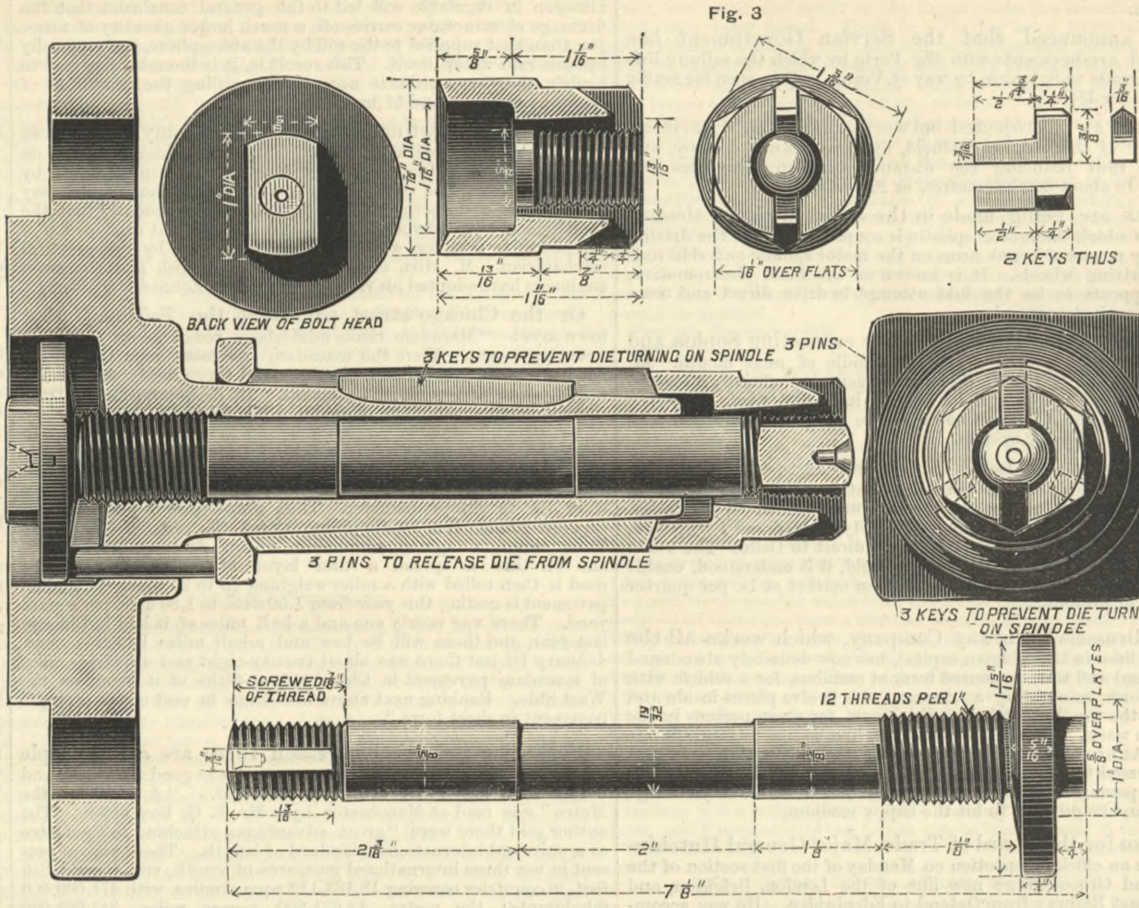


Fig. 3



EXPANDING FACE-PLATE MANDRIL.

THE advantages claimed by the patentees of this useful lathe accessory are as follow:—Medium and heavy work, such as large pulleys, fly-wheels, &c., may be accurately centred and secured by simply turning one bolt head without the use of a hammer, press, or mandril block; also the rim of the pulley or wheel may be in contact with the face-plate. It is specially suitable for varied work, as dies may be changed in a minute without taking the mandril to pieces.

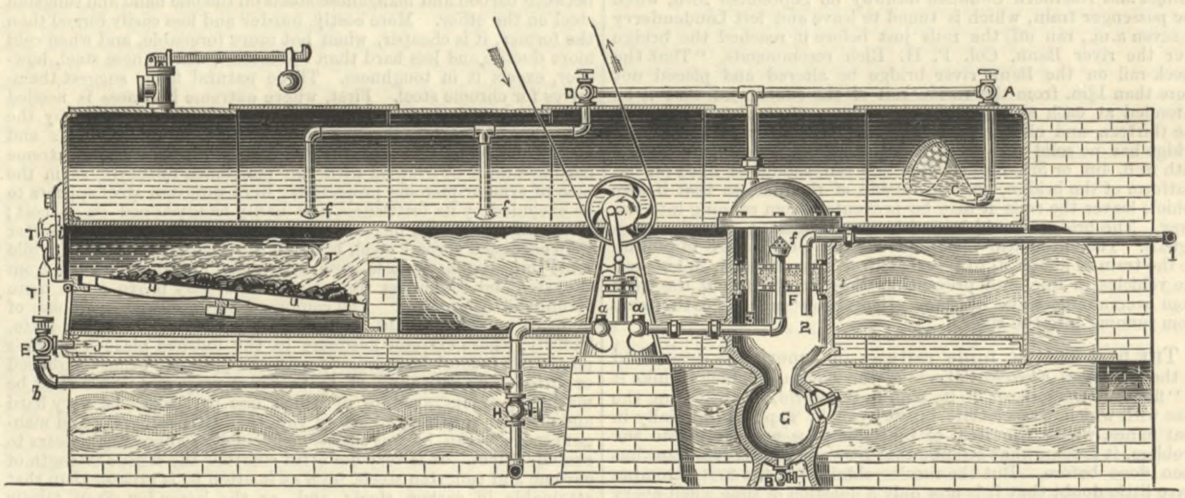
Fig. 1 shows a side elevation of the mandril on a face-plate, the pulley being in part section in order to show the general outline. Fig. 2 is a sectional view of Fig. 1, with letters of reference. Fig. 3 shows the details to a larger scale, grouped. The die B is expanded or contracted by turning a bolt D, which moves it up or down on the taper spindle A, according to the direction in which it is turned. The work is released by means of three pins G, which slide in holes in the flange, and occupy the distance between the bolt-head D and the loose collar F, so that when the bolt is unscrewed the bolt head pushes the pins G, and transmits their motion through the collar F to the die B, which is forced down the taper spindle. The loose pieces of the die are retained in position by having their ends bevelled, which fit corresponding recessed bevels in the nut E and collar F. To release or change the dies the collar F is moved partly round till the three notches or recesses which are cut in it come opposite the pins G, and allow sufficient motion endwise for the pieces of the die to drop out. All parts of the mandrils are made of steel, carefully and accurately finished and hardened where necessary, and every mandril is tested before leaving the works.

THE CROCKFORD BOILER CLEANER, FEED-WATER HEATER, AND PURIFIER.

THE accompanying illustration represents a form of combined boiler cleaner, feed-water heater, and purifier, of which the inventor exhibited models at the American Exhibition, Earl's Court; and which, in a somewhat simpler form, has been fitted to boilers in the United States representing in the aggregate over 5000-horse power. In the simpler form referred to the pump is dispensed with, and the circulation is then effected as follows. The scum and water entering the conical drum or collector C pass by the stop-valve A, and system of pipes terminating at 3, into a closed cast iron vessel, which forms the feed-water heater and purifier, and stands at one side of the boiler. From 3 the water passes up through the filter bed F, formed of slag wool packed between two perforated cast iron diaphragm plates bolted in position as shown, and so enters the conical nozzle *f*, also packed with filtering medium, the heavier impurities having meantime fallen into the globular receptacle G, from whence they are discharged by the blow-off cock B as required. The water having entered the nozzle *f* passes by the pipes shown—the pump being dispensed with—to the elbow *b*, the stop-valve E in this case being replaced by a Y-piece, from which two rising mains, indicated by the dotted lines T, proceed, one to either side of the furnace. These mains pass into and continue, as shown, for some distance along the furnace, where they are exposed to the hottest part of the fire. An efficient circulation is maintained by making the area of the inlet *i*, to which the two mains converge by a second Y-piece, rather smaller than the united areas of the two sets of horizontal tubes, the dimensions in the smallest size being two 2in. arms opening into one of 2½in. diameter, and the increase of velocity in the flow at this point, consequent upon the decrease of area, ensures a steady and continuous circulation. This is well exemplified by the models shown, the risers T being of glass, and so allowing the actual circulation to be traced. If the stop-valve A is closed, water may be supplied to the heater by a feed pump attached to the feed pipe I, the water discharging through the orifice *l*, and following the same course as before, enters the boiler at *i*, while, for the purposes of cleaning, the valve D may be opened, and a valve, placed before the Y-piece and corresponding to E, being closed, the water will then pass by the pipe terminating at 3, and so down through the filtering nozzles *f f* on to the crown of the furnace.

We should, however, here state that the majority of the boilers fitted in America are of the plain cylindrical tubular type set in brickwork, provided with external fixing arrangements, the circulating tubes being arranged in groups of six on each side, and running nearly the whole length of the boiler, their functions corresponding with that of the tubes T. These groups are connected together at the front and back ends by elbows, each set of six being coupled by a Y-piece to a rising main in front, and similarly to a pipe at the back, connected inside the boiler with the collector C. In this case the feed heater and purifier is done away with, each set of tubes being connected by means of a pipe with a wrought iron sediment drum placed at the back end of the boiler, and provided with a blow-off cock. The arms of the Y-pieces have the same relative areas as before explained, and the circulation is set up by the difference in temperature between the water in the boiler and that in the tubes. As applied to a 30-horse power boiler, these tubes present 200 square feet of additional heating surface, and it should be noted that this, coming as it does within the influence of the hottest part of the fire, adds greatly to the efficiency of the boiler.

Turning now to the arrangement as illustrated, it will be seen that the steam and water entering at C passes, the valve A being open, into the heater at 3, the pump drawing the water through the filter F and nozzle *f* as before, and either discharging it into the boiler through the valve E and opening J, or passing it by the valve H into tanks, where it may be stowed as purified water. The pump in this arrangement governs the circulation, but by no means controls the supply, as the valves *a a*, lifting inwards, it follows that a feed-pump attached to I may force any quantity of water through the heater and purifier, even though the circulating pump be at rest, thus allowing of one heater being used to heat and filter the feed-water for a whole battery of boilers. It is obvious that the same facilities for cleaning present themselves in this arrangement also. It may interest our readers to know that all the elbows, bends, and Y-pieces used in the construction of this apparatus are of cast iron, being made from a mixture of Scotch and American pigs and submitted to a test of 500 lb. cold water without any signs of sweating, and though many boilers so fitted have been running for several years, no case of failure through such use of cast iron has yet occurred. Some very clean specimens of these castings were also exhibited by the Crockford Steam Generator Co., of Newark, New Jersey, W.S.A., who are the proprietors of Mr. Crockford's patents.



CROCKFORD'S BOILER CLEANER.

THE SOCIETY OF ENGINEERS.

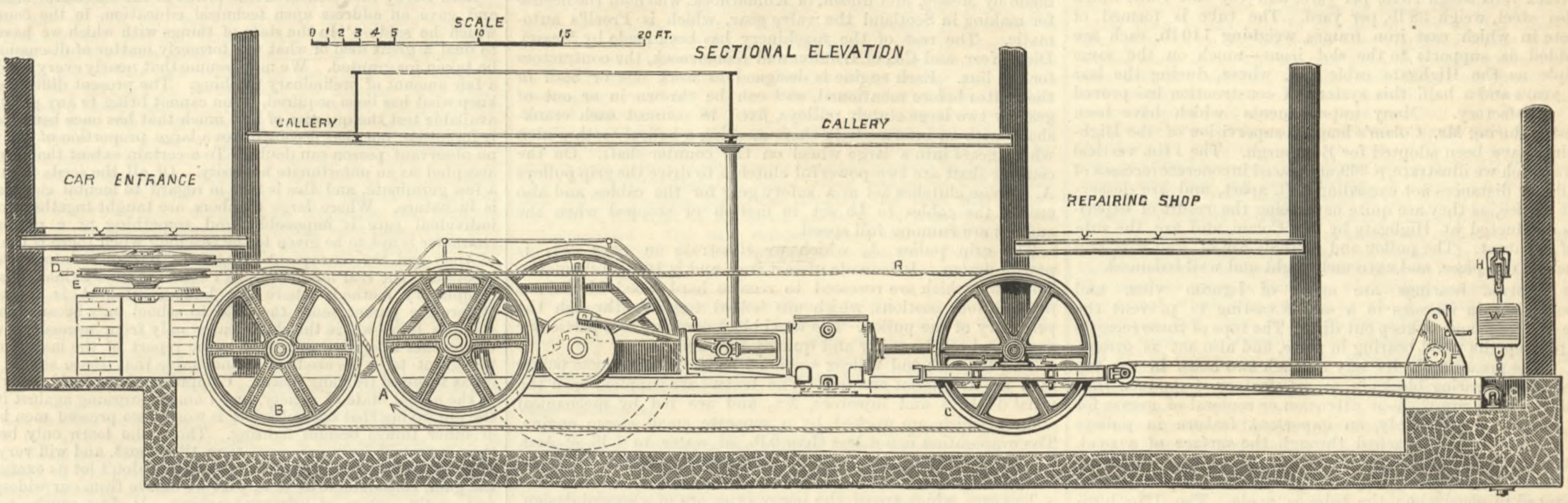
AT a meeting of the Society of Engineers, held at Westminster Town Hall on Monday evening, November 7th, a paper was read by Mr. Perry F. Nursey on "Primary Batteries for Illuminating Purposes." The author described some primary batteries for special purposes and for general lighting; the latter included those of Holmes and Burke, Ross, Coad, Lalande, Skrivanow, Upward, Pollak, Newton, D'Humy, and Friedlaender, and the "Regent," the "Union," and the "Eclipse" batteries. He pointed out their leading characteristics, and observed that some of them had shown themselves to be efficient and useful by the results of their adoption in mansions and large establishments. These included the Upward, the Holmes and Burke, and the Lalande batteries. There was, however, no evidence that they could be applied economically to the lighting of the principal rooms in more modest residences—in a word, for general public domestic lighting. What was required was cheapness and efficiency; cheapness, meaning either a small first cost and cost of maintenance, as in the case of a battery placed in a house, or a moderate charge for a measured supply of the electric current, as in the case of a central distributing station. In a discussion it was pointed out, by Mr. W. H. Preece, F.R.S., that except for special cases, primary batteries—with only one or two exceptions—were not in the least likely to be of any general use or of general application where large currents were required. Their use must be restricted by their cost of working, while the bye-products of their working would remain of no importance whatever in the calculation of the cost. Mr. Desmond G. Fitz-Gerald spoke much in the same strain, but gave some figures from which any-one may calculate the greatest obtainable quantity of electricity from 1 lb. of the materials employed. For instance, the horse-power hours obtainable theoretically from the consumption of 1 lb. of different materials are—E being E.M.F. of the couple of which the material forms an element as follows:—For Zn 2·02 ÷ E; for Fe 1·73 ÷ E; for H_2SO_4 3·02 ÷ E; for H_2NO_3, 3·88 ÷ E; and for Pb O_2 7·38 ÷ E. The peroxide of lead thus stands highest.

THE SOCIETY OF ARTS.—The first meeting of the one hundred and thirty-fourth session of the Society of Arts will be held on Wednesday, the 16th November, when the opening address will be delivered by Sir Douglas Galton, K.C.B., D.C.L., LL.D., F.R.S., chairman of the Council. Previous to Christmas there will be four ordinary meetings, in addition to the opening meeting. For these meetings the following arrangements have been made:—November 23rd, Professor Sylvanus P. Thompson, "The Mercurial Air Pump;" November 30th, J. B. Hannay, "Economical Illumination from Waste Oils;" December 7th, P. L. Simmonds, "The Chemistry, Commerce, and Uses of Eggs of various kinds;" December 14th, Sir Philip Magnus, "Commercial Education." During the session there will be six courses of Cantor lectures—"The Elements of Architectural Design," by H. H. Statham; "Yeast, its Morphology and Culture," by A. Gordon Salamon; "The Modern Microscope"—being a continuation of the recent course of Cantor lectures on the "Microscope"—by John Mayall, jun.; "Alloys," by Professor W. Chandler Roberts-Austen, F.R.S.; "Milk Supply and Butter and Cheese-making," by Richard Bannister; "The Decoration and Illustration of Books," by Walter Crane. Two juvenile lectures on "The Application of Electricity to Lighting and Working," by William Henry Preece, F.R.S., will be given during the Christmas holidays.

THE EDINBURGH NORTHERN CABLE TRAMWAY.

MR. W. N. COLAM, ASSOC. M. INST. C.E., ENGINEER.

(For description see page 390.)



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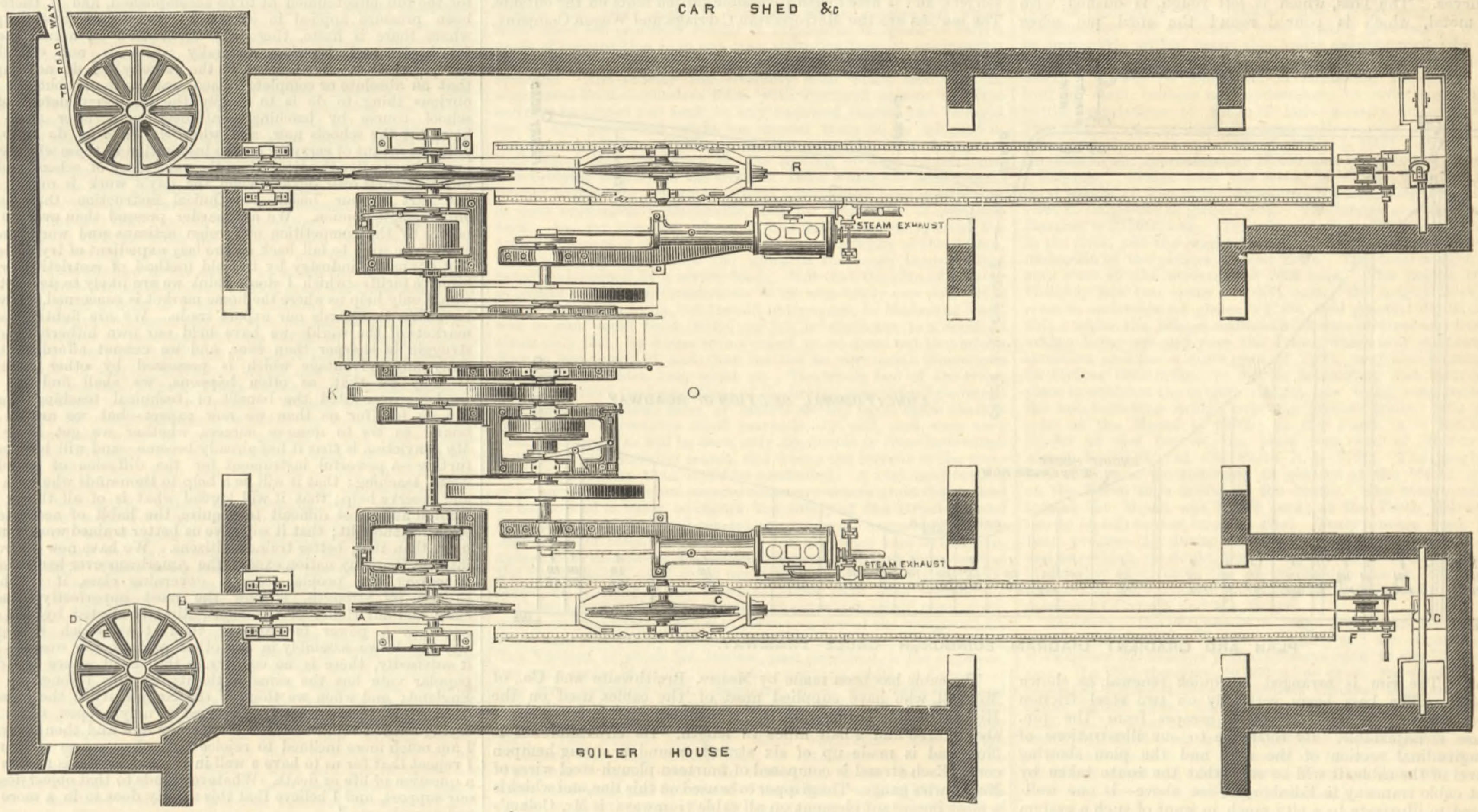


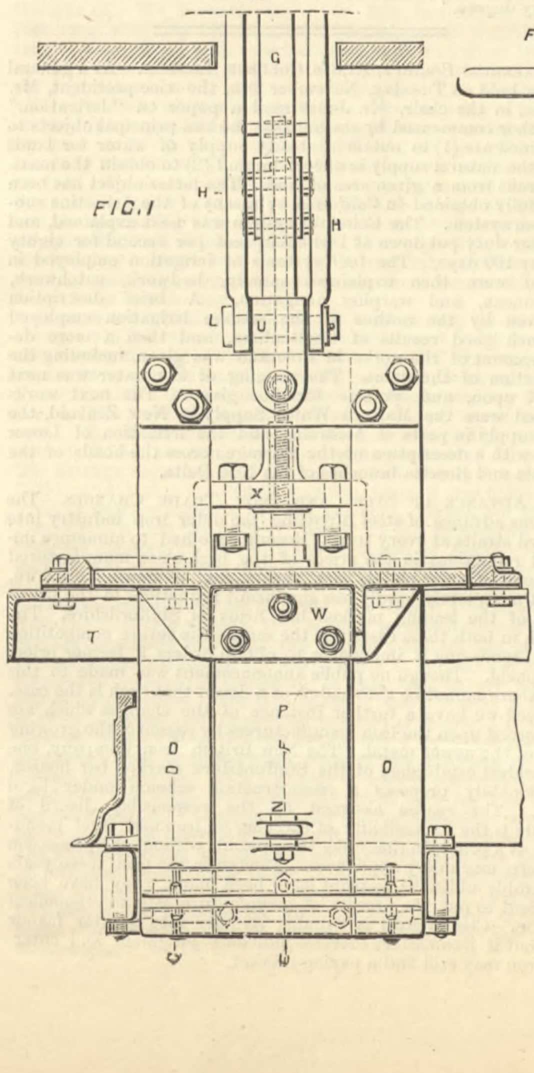


FIG. 1

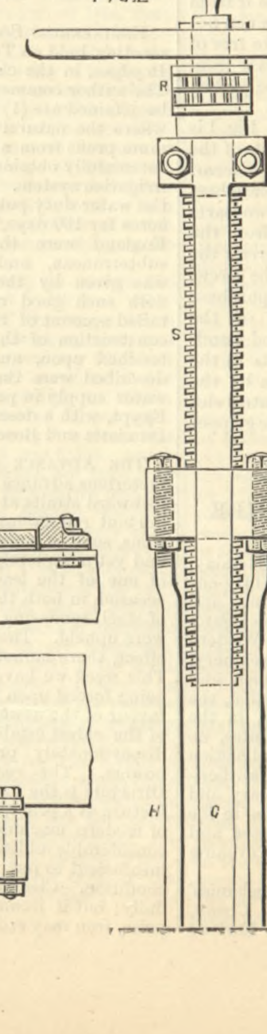


FIG. 2

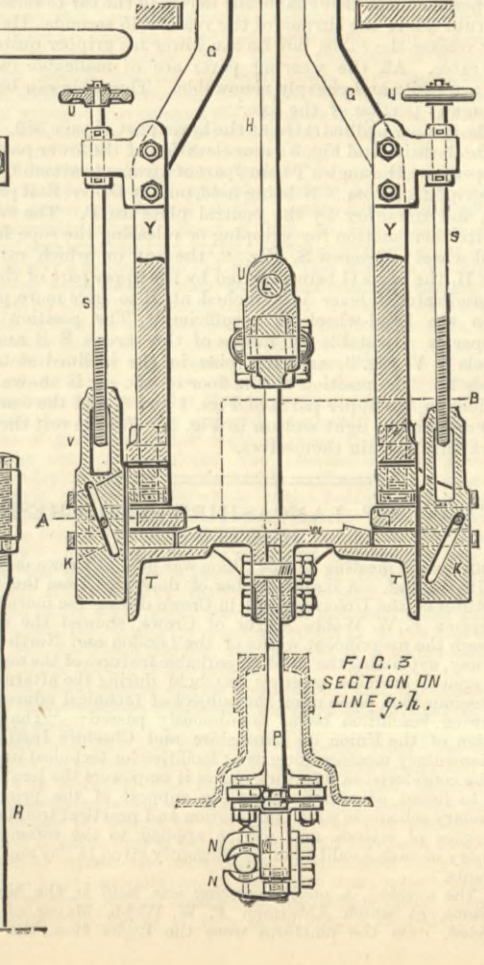


FIG. 3 SECTION ON LINE g.h.

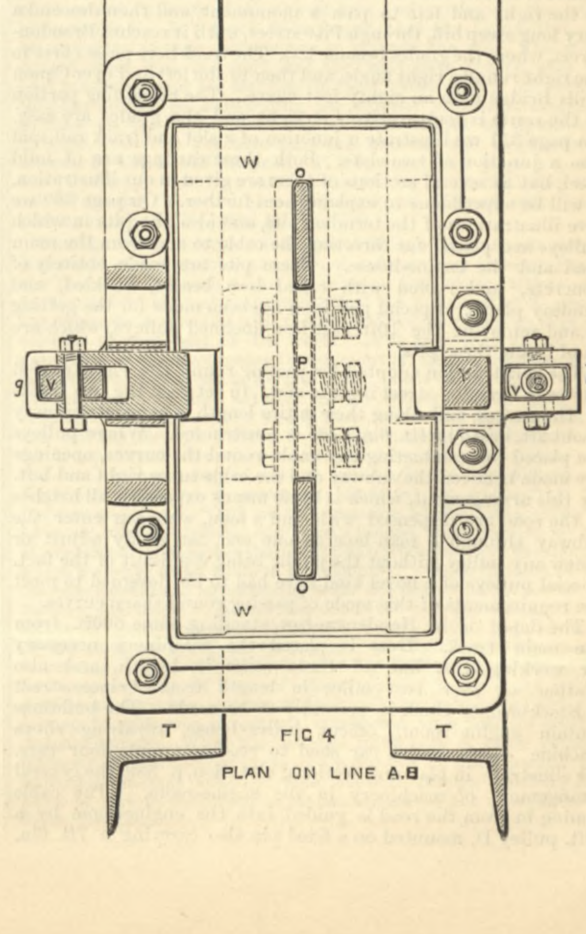


FIG 4

PLAN ON LINE A.B

THE EDINBURGH NORTHERN CABLE TRAMWAY.

On pages 389 and below we publish further engravings of the permanent way and works for this line. It is unnecessary to describe in detail the construction of the roadway and cable, as the sections and plans given on pages 351 and 369 explain themselves. The gauge is 4ft. 8½in. The steel track rails weigh 75 lb. per yard, and the slot rails, which are also steel, weigh 38 lb. per yard. The tube is formed of concrete in which cast iron frames weighing 140 lb. each are embedded as supports to the slot irons—much on the same principle as the Highgate cable line, where, during the last three years and a half, this system of construction has proved quite satisfactory. Many improvements which have been suggested during Mr. Colam's lengthy supervision of the Highgate line have been adopted for Edinburgh. The 14in. vertical pulleys which we illustrate, p. 369, are placed in concrete recesses of the tube at distances not exceeding 48ft. apart, and are deserving of notice, as they are quite new, being the result of experiments conducted at Highgate by Mr. Colam, and are the subject of a patent. The pulley and journals are of cast iron and are each in one piece, and extremely light and well balanced.

The journal bearings are made of lignum vitæ, and are boxed up in recesses in a saddle casting to prevent the escape of grease and to keep out dirt. The tops of these recesses serve to keep the wood bearing in place, and also act as grease-boxes. The grease finds its way through two holes in the top surface of the bearing blocks in so satisfactory a manner that the pulleys have run without attention or renewal of grease for many months continuously, an important feature in pulleys which can only be approached through the surface of a road. The saddle casting with the pulley can be adjusted laterally whilst the cable is in motion by sliding it in the sole plate, which is concreted in place when the tube is made. The 12in. horizontal cast iron pulleys, as illustrated, are used only for very easy curves. The boss, which is left rough, is bushed with white metal, which is poured round the steel pin when in place. The rim is arranged for quick renewal, as shown at p. 369. The boss bears vertically on two steel friction washers running in the oil which escapes from the pin. The base is adjustable. By reference to our illustrations of the longitudinal section of the road and the plan showing the travel of the cable, it will be seen that the route taken by the first cable tramway in Edinburgh—see above—is one well-calculated to illustrate to a city much in want of such a system its adaptability to conditions which are very often erroneously considered fatal to its introduction. The tramway starts with a single line from Princes-street, in the centre of the city, and terminates in a single line at Golden Acre, but the rest of the track is double throughout. The line passes up a sharp hill in Hanover-street, and in crossing George-street the tracks curve to the right and left to pass a monument, and then descend a very long steep hill, through Pitt-street, until it reaches Brandon-street, where the grades become less. The track here passes first to the right round a right angle, and then to the left and over Canon Mills Bridge with an eighty-feet curve. The remaining portion of the route is comparatively straight and the grades are easy. On page 351 we illustrate a junction of a slot and track rail, and also a junction of two slots. Both these castings are of mild steel, but as several sections of them are given in our illustration, it will be superfluous to explain them further. On page 369 we give illustrations of the terminal pits, and also the pits in which pulleys are placed for directing the cable to and from the main road and the engine-house. These pits are made entirely of concrete, and roofed with rolled iron beams, buckled, and Lindsay plates. Special provision has been made for the getting at and removing the 10ft. cast iron inclined pulleys, which are fixed inside these pits.

The construction adopted for passing round the right angled curves in Brandon-street is quite new. In between the two tracks of the curves, and along their entire length, a concrete subway about 2ft. broad by 4ft. 6in. deep is constructed. Where pulleys are placed for conducting the cable round the curves, openings are made between the subway and the cable tubes right and left. By this arrangement, which is by no means expensive, all hatches in the road are dispensed with, and a man, who can enter the subway through a man-hole at one end, can easily adjust or renew any pulley without the public being cognisant of the fact. Special pulleys of a novel kind have had to be designed to meet the requirements of this mode of passing round sharp curves.

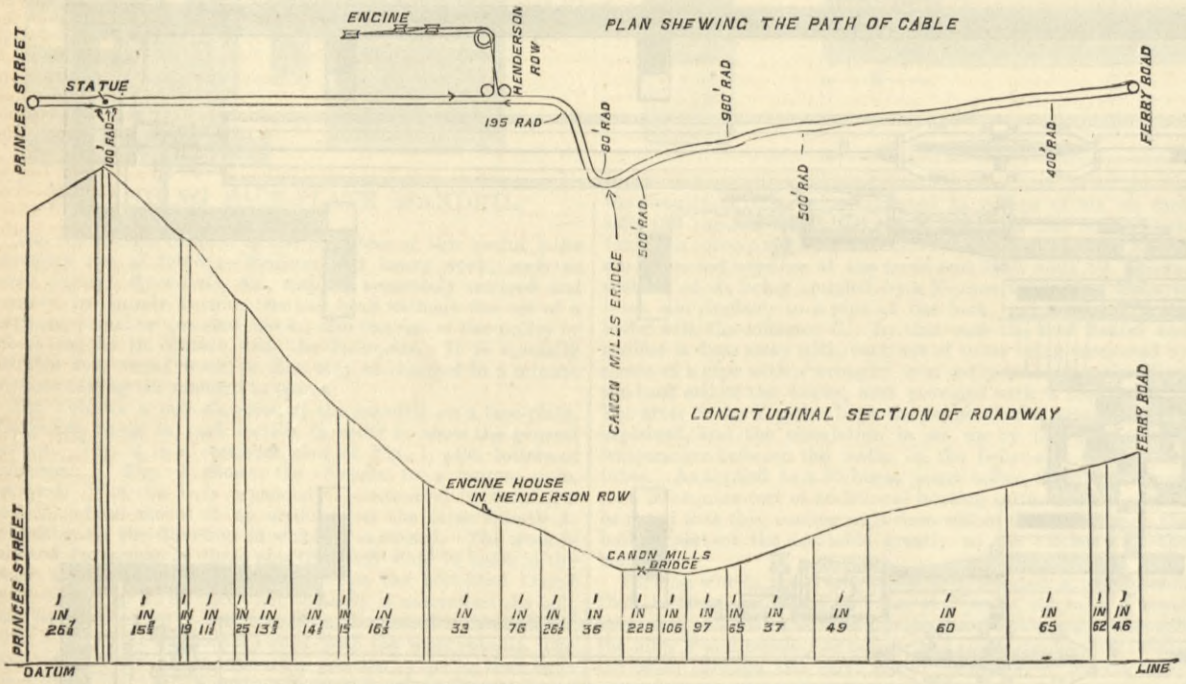
The depôt is in Henderson-row, standing some 600ft. from the main track. Here is placed the machinery necessary for working this line of three miles in length, and also another of over two miles in length from Princes-street to Stockbridge, which is presently to be made. The buildings contain engine-room, offices, boiler-house, repairing shops machine shops, and a car shed to receive twenty-four cars. We illustrate in plan and sectional elevation, p. 389, the general arrangement of machinery in the engine-room. The cable coming in from the road is guided into the engine-room by a 10ft. pulley D, mounted on a fixed pin also carrying a 7ft. 6in. pulley. The cable passes directly into the grip pulley A, over the idle pulley B, and then to a 10ft. pulley, which is mounted on a carriage free to move backward or forwards along rails. From C the cable goes directly to pulley E, and thence into the road again, travelling only 2¼in. from the incoming portion.

The tension carriage is connected with a series of weights W and a winch F. The engines are a pair of horizontal high-pressure cylinders of 20in. diameter and 40in. stroke, and have been made by Messrs. McCulloch, of Kilmarnock, who hold the license for making in Scotland the valve gear, which is Proell's automatic. The rest of the machinery has been made by Messrs. Dick, Kerr, and Co., of London and Kilmarnock, the contractors for the line. Each engine is designed to work one or both of the routes before mentioned, and can be thrown in or out of gear by two large clutch pulleys, fixed to connect each crank-shaft, with an intermediate shaft carrying a helical tooth pinion which gears into a large wheel on the counter-shaft. On the counter-shaft are two powerful clutches to drive the grip pulleys A. These clutches act as a safety gear for the cables, and also enable the cables to be set in motion or stopped when the engines are running full speed.

The grip pulley A, which we illustrate on page 351, is new in design. It is made of cast iron, and is 10ft. in diameter. The jaws, which are recessed to receive hard wood blocks, are made in four sections, which are bolted together through the periphery of the pulley. The wood blocks are cut to a particular angle, and can be easily and quickly renewed.

Two Babcock and Wilcox sectional boilers of 120-horse power each are at present erected. The boilers are supplied with the usual donkeys and injectors, &c., and are fed by mechanical stokers, which are worked by a separate small steam engine. The evaporation is not less than 9 lb. of water to 1 lb. of coal, with the temperature of feed being that of water from an exhaust injector.

The cars, which are of the bogey type, are of a special design, and very handsome. Each car is capable of carrying sixty passengers, and is fitted with reversible garden seats on the outside. The makers are the Metropolitan Carriage and Wagon Company.



PLAN AND GRADIENT DIAGRAM—EDINBURGH CABLE TRAMWAY.

The cable has been made by Messrs. Braithwaite and Co., of Millwall, who have supplied most of the cables used on the Highgate Cable Tramways. It has been delivered in one piece of about three and a-half miles in length. Its circumference is 3in., and is made up of six strands round a strong hempen cord. Each strand is composed of fourteen plough-steel wires of No. 15 wire gauge. The gripper to be used on this line, and which is a most important element on all cable tramways, is Mr. Colam's invention. The chief points of novelty and interest in this gripper are those that enable the driver of the car to raise it from the tube above the surface of the road in 45 seconds. He can not only release the cable, but he can lower his gripper quite free of the cable. All the wearing parts are of malleable cast iron, and are easily and cheaply renewable. The cable can be picked up on any portion of the line.

The gripper is illustrated at the lower part of page 389. Fig. 1 is a side elevation and Fig. 3 a rear elevation of the lower parts of the gripper gear, the angles T being part of a frame to attach to the car, the gripping pieces N N being held, one by the vertical plate bars O O, and the other by the central plate bar P. The two parts receive their motion for gripping or releasing the rope from the hand-wheel and screw S, Fig. 2, the nut on which carries the rods H, the parts G being carried by the upper part of the screw. A hand-ratchet lever is attached at R to give more purchase when the hand-wheel is insufficient. The position of the gripper is adjustable by means of the screws S S and hand-wheels V V, Fig. 3, and the pins in the inclined slots in the pieces K. The position of the floor of the car is shown by the sections in the upper parts of Figs. 1 and 3, and the central slot rails are seen in light section in Fig. 3. For the rest the gripper engravings explain themselves.

UNION OF LANCASHIRE AND CHESHIRE INSTITUTES.

The annual meeting of this Union was held at Crewe on Monday, the 7th instant. A large number of delegates from the fifty-one institutes of the Union arrived in Crewe during the morning; and Alderman F. W. Webb, Mayor of Crewe, showed the delegates through the magnificent works of the London and North-Western Railway, explaining the most remarkable features of the machinery. The annual business meeting was held during the afternoon, and discussions took place upon the subject of technical education, the following resolution being unanimously passed:—"That, in the opinion of the Union of Lancashire and Cheshire Institutes, no parliamentary measure for giving facilities for technical instruction can be considered satisfactory unless it empowers the local authorities to found or contribute to the support of the primary and secondary schools in which instruction and practical training in the principles of science and art as applied to the commerce and industry of each locality can be efficiently given to day and evening students."

In the evening, a public meeting was held in the Mechanics' Institute, at which Alderman F. W. Webb, Mayor of Crewe, presided. On the platform were the Right Hon. the Earl of Derby, K.G., Sir Richard Moon, chairman of the London and North-Western Railway, Mr. W. S. B. M'Laren, M.P., and a number of prominent local gentlemen who are interested in education.

The chairman gave a brief sketch of the work which the Crewe Mechanics' Institute had accomplished since its foundation in 1845. He said that no fewer than twenty Whitworth and nine Ramsbottom scholarships, not to speak of many other awards, had been gained by the pupils of the Institute.

Lord Derby then delivered the prizes to the successful students, and gave an address upon technical education, in the course of which he said:—"In the state of things with which we have now to deal a great deal of what was formerly matter of discussion can be taken for granted. We may assume that nearly every child gets a fair amount of preliminary teaching. The present difficulty is to keep what has been acquired. You cannot bring to any practically available test the question of how much that has once been learned is forgotten, but that it constitutes a large proportion of the whole no observant person can doubt. To a certain extent that must be accepted as an unfortunate necessity. Of all the seeds sown only a few germinate, and this is true in regard to mental culture as it is in nature. Where large numbers are taught together, minute individual care is impossible, and something of a mechanical character is apt to be given to the teaching when there is the want of time and the consequent struggle to put more into it than is possible. The real mischief is, as I conceive, due to inadequacy of compulsory methods where the human intellect is concerned. Where the parent sends the child to school only because the law compels him—where the child learns only from necessity—where the teacher is looking primarily to the report of the inspector and the grant to be secured—it is inevitable that there should be a great waste of teaching power. Compulsion is probably inevitable in the actual state of society, and I am not arguing against it, but the old saying that one volunteer is worth two pressed men is true of other things besides fighting. Those who learn only because they must will learn no more than they must, and will very soon forget the greater part of that. Therefore, don't let us exaggerate the gain, considerable as it is, that we derive from our widespread and costly system of primary teaching. It does much—nobody would deny that—but it leaves much undone. It ends too soon for the full effect aimed at to be accomplished, and if there had been pressure applied in excess, as sometimes must happen, where there is haste, there will be created an actual distaste for books and learning generally which is not quickly or easily got over. Well, what is the remedy? I do not suppose that an absolute or complete remedy can be found, but the most obvious thing to do is to supply the necessary defect of the school course by teaching continued to a later age. We have got the schools now, and what we have to do is to provide the means of carrying on the instruction of those who are willing to learn after the time when they are clear of school and free to follow their own devices when the day's work is over. As to one part of your business—technical instruction—there is now only a single opinion. We are harder pressed than ever we were before by the competition of foreign artisans and workmen, and even if we were to fall back on the lazy expedient of trying to protect our native industry by the old method of restrictive or prohibitive tariffs—which I don't think we are likely to do—yet that would only help us where the home market is concerned. It would be useless as regards our export trade. We are fighting for the markets of the world—we have held our own hitherto; but the struggle is sharper than ever, and we cannot afford to throw away any advantage which is possessed by other countries. It may be that, as often happens, we shall find out that we have over-rated the benefit of technical teaching—that it can do less for us than we now expect—but we are at least bound to try to deserve success, whether we get it or not. My conviction is that it has already become—and will become still further—a powerful instrument for the diffusion of sound and useful teaching; that it will be a help to thousands who both need and deserve help; that it will spread what is of all things most wanted and most difficult to acquire, the habit of accurate and scientific thought; that it will give us better trained workmen and, more than that, better trained citizens. We have now a stronger interest than any nation except the Americans ever had before in educating our people, for the governing class, if it chooses to use its strength, is now the most imperfectly educated class, and our House of Commons, directly elected by that class, exercises a power far greater than that which belongs to any legislative assembly in any other part of the world. I say it advisedly, there is no country in the world where the direct popular vote has the same authority as now belongs to it in England; and when we think of the complexity of the questions dealt with and the interests involved it may happen, so far from crying out if I think that the democracy now and then go wrong, I am much more inclined to rejoice that they are so often right. I repeat that for us to have a well-instructed people is no less than a question of life or death. Whatever tends to that object deserves our support, and I believe that this society does so in a more than ordinary degree."

Engineering Society, King's College, London.—At a general meeting held on Tuesday, November 8th, the vice-president, Mr. Brydges, in the chair, Mr. Jones read a paper on "Irrigation." The author commenced by stating that the two principal objects to be attained are (1) to obtain a steady supply of water for lands where the natural supply is uncertain, and (2) to obtain the maximum profit from a given area of land. The latter object has been successfully obtained in California by means of the Asbestine sub-irrigation system. The Colorado system was next explained, and the water duty put down at 1·44 cubic feet per second for eighty acres for 100 days. The four systems of irrigation employed in England were then explained—namely, bedwork, catchwork, subterranean, and warping irrigation. A brief description was given by the author of the sewage irrigation employed with such good results at Cheltenham, and then a more detailed account of the works in Colorado was given, including the construction of the dams. The gauging of the water was next touched upon, and Francis' formula given. The next works described were the Malvern Water Supply in New Zealand, the water supply in parts of Australia, and the irrigation of Lower Egypt, with a description of the Barrage across the heads of the Damietta and Rosetta branches of the Nile Delta.

The Advance of Steel and Iron Trade Changes.—The victorious advance of steel is putting the older iron industry into awkward straits at every turn. Recently we had to announce important reductions in the prices of the high-class manufactured irons, such as boiler plates, bars, sheets, &c., of South Yorkshire, and yet more lately hardly less significant reductions in the prices of one of the leading marked bar firms of Staffordshire. The occasion in both these cases was the same—the severe competition of steel rendering it impossible to obtain orders if former prices were upheld. Though no public announcement was made to this effect, there cannot be the shadow of a doubt that such is the case. This week we have a further instance of the changes which are being forced upon the iron manufacturers by reason of the growing favour of the newer metal. The New British Iron Company, one of the oldest established of the Staffordshire marked bar houses, dispassionately proposes a reconstruction scheme under legal powers. The reason assigned by the responsible Board of Directors is the impossibility of carrying on iron and steel manufacture at a profit, in times like the present, without the possession of modern machinery appliances. Though in the past three years considerable additions to plant have been made, they have been insufficient to put the process of manufacture into an economical condition. Clearly steel is winning its way into greater favour daily; but if ironmasters exercise judicious judgment and enterprise, iron may still find a paying market.

THE INSTITUTION OF CIVIL ENGINEERS.

PRESIDENTIAL ADDRESS.

On Tuesday evening Mr. George B. Bruce, president, addressed the meeting in the following terms on assuming the chair, for the first time, after his election:—

Since we last met here under the presidency of my esteemed predecessor, Mr. Woods, our most gracious Queen has completed the fiftieth year of her reign, and, however hopefully the people of these realms, and of this vast empire, greeted her Majesty when she first took her seat upon that throne, these feelings were but feeble compared with the deep sense of thankfulness and gratitude with which the nation can look back upon the reign of a monarch in whose life, through all these years, the dazzling light which strikes upon a throne has revealed no flaw. As her Majesty's loyal subjects we have had, and may yet have, many opportunities of reviewing these fifty years of her reign from various standpoints, social, commercial, political, and religious, all of which would be out of place within these walls. We, however, as an Institution and as a profession, have had our own part to play in the nation's and in the world's advance during these fifty years, and I do not know that I can do anything more fitting now than draw your attention to some of those changes which have come over the practice of the profession, and some of the achievements which it has accomplished during those years, so far as the limited time at our disposal this evening will admit.

When her Majesty came to the throne, on June 20th, 1837, there were 238 members of all classes. On June 20th, 1887, there were 5396 members of all classes. And the total income of the Institution at the respective dates was £713 and £21,015, and beyond the increase of this Institution itself, we must notice that it stands as a mother amongst the nation. From it has sprung many kindred societies, dealing with sections of those great questions which fall within the all-embracing profession of a civil engineer, civil as distinguished from military. There is the Institution of Mechanical Engineers, of Telegraph Engineers, of Naval Architects, the Iron and Steel Institute, all of which we regard as helping to do, in sections, what it is committed to this Institution to have regard to and care for as a whole. The profession must have believed thoroughly in the value of this Institution, and society must have endorsed that estimate, or it could never have grown in numbers and importance as it has done. Times may change, numbers may diminish, but it is hardly conceivable that the value of the Institution of Civil Engineers to the profession and to the world can ever grow less. As I entered the works of Robert Stephenson, in Newcastle, a few months before her Majesty ascended the throne, in comparing things as they were then, and subsequently, with what they are now, I shall draw, to some extent, at all events, upon my own knowledge and experience, whilst in some departments I have had largely to depend upon friendly aid, generously given, and now most gratefully acknowledged.

Engineer's workshop.—Having begun my profession in the workshop, it is not unnatural that I should look there first. There is probably nothing more striking than the change which has come over an engineer's workshop in these fifty years, and the most important feature of that change is the extent to which the use of machine tools has driven out hand-labour. In 1837 good workmen could chip and file by hand almost as true as a machine could do it; now I suspect there are comparatively few who are adepts at the old art, the introduction of machinery having rendered it comparatively unnecessary. In 1837 there were in Robert Stephenson's shops no small planing or shaping machines, which now play so important a part in every engineer's shop. There was only one slotting-machine, the use of which was very restricted. Wheels were driven on to their axles by sledge-hammers, wielded by strong arms alone. Steam-hammers were of course unknown, and only hand-labour was available for the ordinary work of the smith's shop and boiler-yard, with the exception of the punching and shearing-machines. Rivetting by machinery, and especially by hydraulic machinery, which has wrought such changes, and without which some work done now would hardly have been practicable at all, was unknown. It is scarcely credible, but it is a fact, that there was not a single crane in Robert Stephenson's shops in 1837. There were shear-legs in the yard, by which a boiler could be lifted on to a truck, and there were portable shear-legs in the shop, by the skilful manipulation of which, at no little risk of life and limb, wonders were done in the way of transmitting heavy loads from one part of the shop to another. And the only steam engine in that which was the most important locomotive shop in the world of that day, was a vibrating pillar engine, with a single 16in. cylinder and 3ft. stroke. How changed is the shop of to-day, with its overhead traversers and its ground traversers and cranes, and appliances worked by power for lifting and moving heavy weights in all directions, with very little manual labour at all. The introduction of steel in place of iron, and the immense size of marine engines now constructed, have necessitated the application of machine tools of a size and strength never previously thought of. We recently heard, in this Institution, of lathes 75ft. long, weighing 100 tons, and turning pieces weighing more than 60 tons, where with four tools each taking a cut of 1½in. deep and ¼in. thick, giving a yield of steel turnings at the rate of 10 tons per day of ten hours if worked centinuously. Also another lathe with eight tools, which removes 20 tons of steel in a day of ten hours, on the same supposition of continuous working. Planing machines are now made up to a weight of 90 tons, to deal with objects weighing from 60 to 70 tons, and operating over surfaces of 20ft. by 15ft. These are but illustrations of the enormous increase of power and capacity of tools now found in the shops of engineers, and the application of machinery in place of hand labour is not less conspicuous in all other departments of an engineer's work. In a marked degree is this to be seen in the very extensive use of wood-cutting machinery, where fifty years ago there was nothing to be found but a circular saw.

Changes in position of workmen.—It is interesting to observe the changes which have come over the condition and position of workmen during the period under review In 1837 the wages of an engine erector in Newcastle were 23s. per week, working sixty-one hours; in 1887 the wages are 32s. per week, working fifty-four hours. The increase in money earned is 9s. per week, or 39 per cent. The rise in rate of pay per hour is from 4·52d. to 7·10d., equal to 2·58d., or an increase in wages per hour of 57 per cent. The average wage per hour during the first twenty-five years was 5·03d., and during the last twenty-five years it was 6·36d., which gives an average increase of 26·4 per cent. When we take into consideration that the prices of nearly all the necessaries and the ordinary comforts of life, with the exception of English beef and mutton, are greatly less than they were in 1837, it is very clear that the position of the British mechanic has immensely improved during the reign of Queen Victoria; for though I have only dealt with one class of workmen, that is fairly representative of the rest. We are constantly told that the difficulty Britain has in holding its own in the markets of the world is due to our want of technical education. There is something in this, but, in my judgment, comparatively little. The true cause of the difficulty is the large increase in wages and diminution in hours of labour. It would be pleasant to think that this was not so, but I have not the shadow of a doubt that it is the main cause of the difficulty of meeting foreign competition. It is a matter of sincere congratulation that employers now really lay themselves out to care for the comforts of their workmen. There are rooms and halls provided where their meals can be cooked and partaken of comfortably, and where books and newspapers can be read, for all of which there was absolutely no provision in my young days. This is a vast improvement, for if any sin has in the past lain at the door of the British manufacturer, it has been in the direction of a want of care for the social, moral, and religious surroundings and well-being of his workpeople.

Locomotives.—In locomotives themselves great changes have been wrought since 1837, whilst, however, the main features of the engines of that time have been preserved. It is rather in the size, weight, and power, and in the increased pressure of steam used and to be provided for that the changes are to be found. In 1837, locomotives with which I, as a youth, had something to do, were made at Robert Stephenson's, and sent on to the Grand Junction Railway to work the ordinary passenger traffic between Liverpool and Birmingham. These engines had 12½in. cylinders, 5ft. driving-wheels, and weighed in working trim only 9 tons 12 cwt., of which 4 tons 7½ cwt. was on the driving axle. The well-known North Star, made for the Great Western Company in the same year, though it had 16in. cylinders, with 16in. stroke and 7ft. driving wheels, only weighed, as registered in the books of the maker, in working trim 12 tons 12 cwt., a weight greatly less than is now put upon a metre-gauge railway. Locomotives used for similar duty on English railways in 1887 are greatly more powerful, weighing usually about 40 tons, with weights varying from 14 to 17 tons on the driving axle, and are worked at a pressure of say 140 lb. per square inch, being 2·3 times more than the pressure in use in 1837. It should be noted that the bogie, which was in the first instance sent out to America from this country, has been now largely adopted in the land of its birth, where for so many years it was not recognised. The only radical change introduced into locomotives has been the application of compound cylinders, upon which it is too early to pronounce any confident judgment based on experience.

Public works.—In the construction of public works great changes have come over the practice of the profession during these fifty years, and these have been to a large extent brought about or facilitated by two main causes, viz., the very extensive introduction of iron and steel instead of masonry, and the introduction of concrete made with Portland cement in foundations, walls, and other structures.

Bridge foundations.—Fifty years ago or less, speaking generally, if the piers of a bridge or the walls of a dock required to be placed where a sufficiently firm bearing strata could only be reached at a considerable depth below that at which it was convenient to place the masonry foundations, the plan followed was the insertion of timber cofferdams, and within these the driving of timber bearing-piles to the depth required to reach such strata. The number of bridges and other works in this country so constructed which have stood for centuries render it impossible to speak of such a mode of construction as in any way defective from an engineering point of view; though for other reasons it is not now very often followed. The facility and economy with which iron—and in some cases brick—cylinders filled with Portland cement concrete can now be placed and sunk to any required depth, and brought up to any prescribed height has caused them to be adopted in the great majority of cases, and has wrought in a few years little short of a revolution in the sinking of deep foundations. The bridging of some of the rivers of India which has been accomplished within this generation would hardly have been possible, or at least economically practicable, but for this mode of construction. As, for instance, where it has been necessary, from the treacherousness of the river bed and the uncertainty of the stream, to sink the cylinders 100ft. and upwards to secure them against being undermined by a severe flood. Not that the plan of sinking cylinders or wells for foundations is an absolutely new one. It is a very old one in India, but the old native plan, in Madras at least, was to sink small brick wells, say 5ft. in diameter, to a depth of about only 15ft., by divers who worked in no dress but that which Nature has provided, and thus limited to very small dimensions the depths to which they could go. The whole bed of the river, for the width of the foundations of the bridge, was virtually covered with masonry, either piers or inverts resting upon these shallow wells. Such structures stood marvellously well, and were very cheap, but were, as will be seen, only applicable to river beds which were dry in the working season, and where the torrent in the monsoon was not more than could be controlled. A vast modification of principle and practice became necessary where great depths had to be reached in order to ensure the safety of the structure, and for this iron and Portland cement concrete were necessary. By the application of machinery such as is not necessary here to describe, cylinders or caissons of the largest diameter, such as those used at the Forth Bridge, or of great depth though of more moderate diameter, as in many of the rivers of India, have been successfully dealt with, and works skilfully carried out which would have otherwise been impossible. We may refer to a few of the bridges which have been founded by means of cylinders or caissons. The new Tay Viaduct, of which Mr. Barlow, past president, is the engineer, has main spans of 245ft., each pier carrying which is formed of two iron cylinders 23ft. diameter, filled with brickwork and concrete, and sunk to depths varying from 20ft. to 30ft. into and resting upon sand, the depth of water at high tide being 23ft. The weight borne by each superficial foot in the cylinders, including rolling load, is estimated at 3 tons. The "Empress" Bridge over the Sutlej, in India, has spans of 250ft., and each pier is formed of three brick wells of 19ft. outside diameter, and they are sunk on an average 110ft. into the bed of the river. The bridge over the Ganges at Benares, with spans of 335ft., has its piers composed of single iron caissons of oval shape 65ft. long by 28ft. broad, lined with brickwork and filled with concrete. These are sunk to a depth of about 100ft. The bridge over the river Hooghly, thirty miles above Calcutta, of which Sir Alexander Rendel and Sir Bradford Leslie were engineers, has a central cantilever carried on two piers, which were founded by means of wrought iron caissons 66ft. long by 25ft. wide, with semi-circular ends. These were sunk to a depth of 73ft. into the bed of the river, and 108ft. below the lowest water level. Each caisson had in it three excavating compartments, through which the earth was excavated by means of vertical annular boring shafts driven by steam power, and armed at the bottom with radial cutters, which excavated circular holes of 10ft. to 15ft. The material excavated was removed by a current of water flowing up the hollow shaft and over a syphon into the river. The flow was maintained by pumping water into the excavating chambers and keeping it at a higher level than the water in the river. In the foundations of the Forth Bridge the caissons are of very large dimensions, being 70ft. in diameter, and the deepest reached depths varying from 71ft. to 89ft. below high water, and from 39ft. to 43ft. into the bed of the Forth. In the case of the other bridges referred to—excepting that over the Hooghly—the caissons or cylinders were sunk by having the material excavated from the inside by means of grabs and other tools working from the open top, but in the case of the Forth, the pneumatic process was in the main adopted. The men worked in a chamber of compressed air 7ft. high, occupying the whole of the bottom surface of the caisson, the chamber being filled with concrete after the caisson reached its proper depth. One of the most remarkable instances of the sinking of foundations by means of iron caissons was exhibited in the erection of a graving dock at Toulon. Here the caisson was 472ft. long by 134ft. wide and 62ft. deep, and embraced the entire dock, which was built of masonry. The excavation necessary for sinking it was carried on, as in the case of the caissons for the Forth Bridge, by the use of a compressed air chamber in the bottom of the caisson.

Portland cement concrete and its applications, and the changes in methods of construction which have followed its introduction, were next dealt with.

Malleable iron and steel in bridges.—Passing from this, let us now look at an ordinary line of railway as made to-day and compare it with a similar line made fifty years ago. Apart from known developments due to increase of traffic, involving, as this does, increase of weight of permanent way and rolling stock, increase of accommodation at stations, vastly increased protection in the way of signals and telegraphs, the principal difference discerned will be the substitution of malleable iron girder bridges for the brick or stone arched bridges of the earlier date. I am not here speaking of bridges of very large span, which are in most cases necessarily of iron, but of the ordinary road, river, and accommodation bridges where the engineer has the choice of adopting either stone or iron. There are some difficulties and constructive dangers avoided in putting up flat malleable iron girders instead of arches. There are no centres to be made, and contractors prefer the iron, for they can easily calculate their profit. Whatever the cause, the graceful and time-honoured arch has largely given way to a substitute which has neither grace nor beauty about it, and which should therefore be avoided except where the physical conditions to be obtained cannot be secured by the adoption of the arch. In this respect I venture to think that former days were better than to-day, that in the use of iron in this direction we have gone to an extreme, and that engineers would do well to retrace their steps, and not use flat iron girders where a brick or stone arch is admissible, to which such girders are greatly inferior both as regards appearance and durability. Where would the works of past centuries have been now had they been of iron? Cast iron arched bridges of considerable spans, such as those over the Wear at Sunderland, with a span of 200ft. and 30ft. versed sine, and the Thames at Southwark, with a span of 240ft. and 24ft. versed sine, and the Bonar Bridge, in Ross-shire, of 145ft. span and versed sine 21ft., were erected in this country towards the end of last or the early part of this century; but malleable iron bridges of large spans, which are now so numerous, and form so important a department of the work of the civil engineer in 1887, were—other than suspension bridges—all but unknown and untried in 1837. The stimulus given to this form of construction may fairly be said to be that which was applied by the Admiralty in 1845 in the conditions laid down by them, according to which the Menai Straits were to be crossed by the Chester and Holyhead Railway, and a free seaway for shipping preserved. In carrying out these conditions, Robert Stephenson erected the rectangular tubular girders of 458ft. span without any scaffolding. And though this exact form of girder has not been frequently adopted, it cannot but be regarded as the ante-type of all such large horizontal girders as have been erected since, whether made of solid plates or lattice framing, whether rivetted or fixed with links and pins. And the erection of the Britannia Bridge gave an immense stimulus to the use of iron generally for bridges. The investigation necessary before the details of the design of the Menai Bridge were decided on added largely to the knowledge of engineers in the construction of malleable iron bridges, which knowledge subsequent investigation and experience have greatly increased. It would be impossible within reasonable limits even to name the various large iron bridges which have since been erected all over the world. It will be sufficient, as indicating the great size of iron or steel bridges now undertaken, to refer again to those to the foundations of which I have already drawn attention. The Tay Bridge is 10,870ft. long, rather more than two miles. From bed of river to underside of girders is 100ft.; and the viaduct contains in all, approximately 18,000 tons of iron and steel. The "Empress" Bridge over the Sutlej is 4224ft. in length, with a total weight of iron in the structure 6704 tons, height from bed of river to underside of girder, 82ft. The bridge over the Ganges at Benares is 3518ft. long. There is sometimes 100ft. depth of water in the river, and the height from the foundation of the piers to the underside of the girders is about 224ft. The total weight of iron and steel in the structure is 7600 tons. The bridge over the Hooghly has two spans of 540ft. each; the height from bed of river to underside of girder is 118ft., and greatest depth of water 86ft.; while the bridge contains 4781 tons of steel and iron. The bridge being erected over the Indus, which is of cantilever construction, and has a clear span of 790ft., may also be mentioned. In further illustration, it will be interesting and instructive to place in contrast the largest viaduct now being constructed with the epoch-making bridge over the Menai Straits. The greatest span at the Menai is 459ft.; at the Forth it is 1661ft. The height of the top of the piers from bed of Straits at the Menai is 220ft.; at the Forth it is 570ft. The height from bed of Straits to underside of girders at the Menai is 161ft.; at the Forth it is 360ft. in the centre. The total quantity of iron at the Menai was 11,468 tons; at the Forth there will be nearly 50,000 tons of iron and steel. Truly a noble work to have been progressing during the celebration of the Queen's Jubilee, and one which, no doubt, when completed, will be more astonishing in its day than even the Menai Bridge was in 1850, and will redound to the honour of our past president, Sir John Fowler, and member of Council, and Mr. Baker.

Railways.—The progress of railways during the last fifty years may be shortly told. In 1837, as nearly as I can ascertain, there were under 200 miles of public railways open in the United Kingdom. In 1887 there are 19,332 miles open, representing a total capital of £828,344,254. In British Colonies the length open is about 22,000 miles. In India, in September, 1886, there were 12,572 miles open, and the capital expended up to December, 1885, was £166,146,651. It is not possible to realise the full importance of this introduction and extension of railways as a factor in the world's progress and advancement, all within these fifty years.

(*To be continued.*)

The Lifeboat Service.—We have received a communication from the Committee of the Royal National Lifeboat Institution, in which they state that they feel they have no alternative but to make an urgent appeal to the British public for funds to enable them to replace a considerable number of their 291 life-boats now on the coast by boats of the newest type and possessing the latest improvements. It is much to be hoped that the Committee will be supported in their endeavours to provide the men, who nobly hazard their lives in order that they may save others, with the best possible means for carrying on their great work. It appears that the Committee have during the current year been compelled to draw on the Institution's capital to the extent of upwards of £18,000, and it is probable that this amount will be greatly increased by the end of the year. It is to meet this large expenditure, and to provide for a continuance of the work, that they now ask for funds. The cost of a fully equipped lifeboat, with transporting carriage, life-belts, &c., is £700.

The Railway System of South Africa.—The announcement just made of the opening of a line of railway from Delogoa Bay to the Transvaal in South Africa indicates an advance in railway communication which may materially affect the judgment of the varying interests connected with the general system of railways in our colonies of that part of the world. It is true that as yet this enterprise of the Portuguese Government is isolated from the general network of our South African lines; but it can scarcely be that the extension of that network in the future can be altogether unaffected by the results which may follow the construction of this railway through what is, to British interests, alien territory, for it taps by short route comparatively from the coast, the goal towards which so many of our own railways in the Cape Colony and Natal are intended to converge. And yet, to quote from the *Colonies and India*, "The railway question at the Cape seems to have got into inextricable confusion; indeed, it appears to be one of a batch of routes rather than a national development in the sense in which railways assist trade in this country." Each division of the colonies appears to be disputing with the others as to routes for railway extension. Meanwhile, while the fighting among themselves is going on, the Transvaal, which is the goal of most of the lines of the Cape Colony and of Natal, is being opened to communication with the seaboard by foreign enterprise. The future prosperity of both of those colonies is certainly largely dependent upon the success of their mining industries; yet gold mining is, with rare exceptions, conducted at a loss for want of communication. While the colonies think only of their persona. interests, and fail to recognise the wider one we have named, it is to be feared that advance made through foreign territory may prove of serious detriment to the realisation of the prosperity we desire for them.

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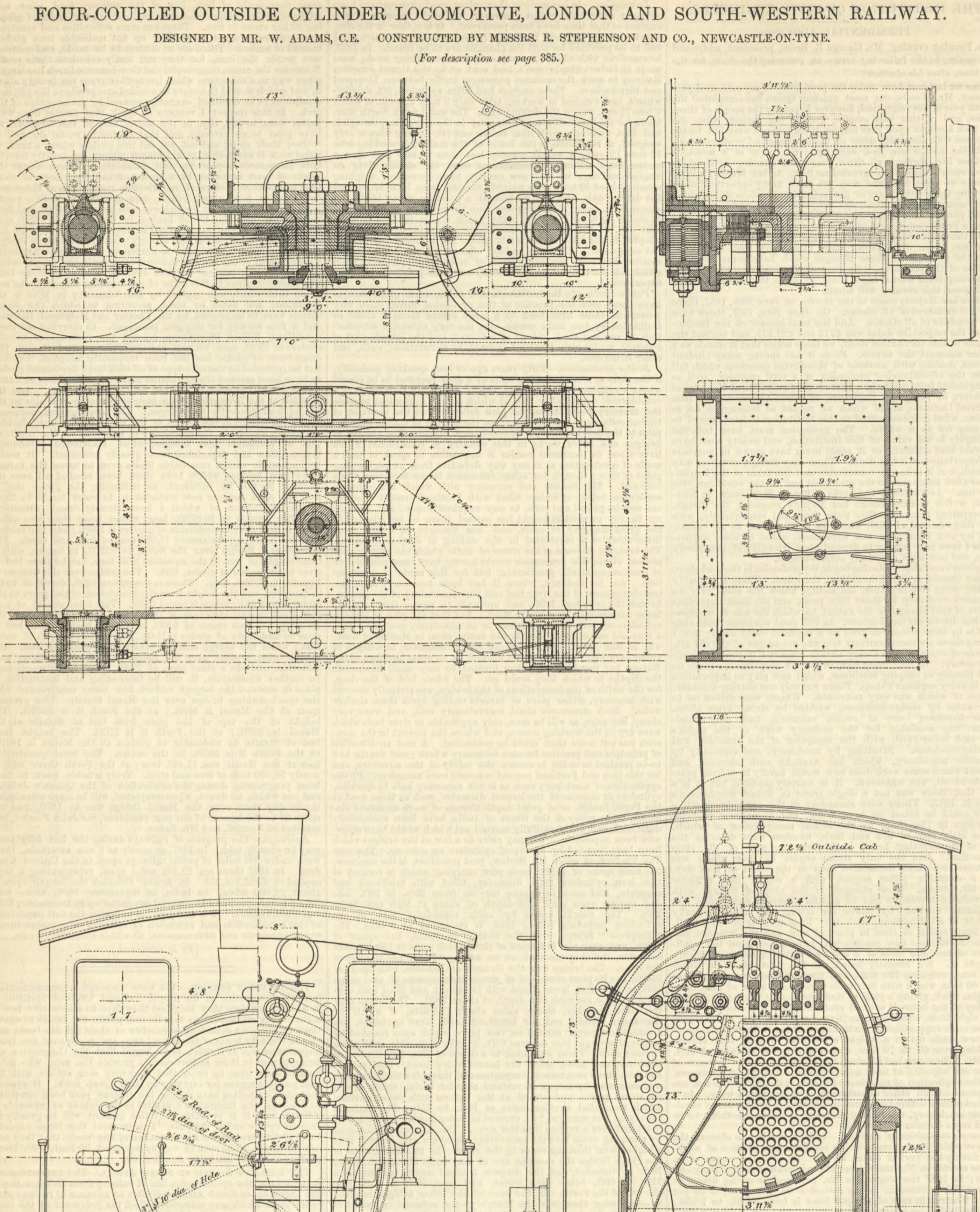
DESIGNED BY MR. W. ADAMS, C.E. CONSTRUCTED BY MESSRS. R. STEPHENSON AND CO., NEWCASTLE-ON-TYNE.

(*For description see page 385.*)



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Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.

Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. George Leopold Riche; all other letters to be addressed to the Editor of The Engineer, 163, *Strand.*

MEETINGS NEXT WEEK.

The Institution of Civil Engineers.—Tuesday, November 15th, at 8 p.m.: Ordinary meeting. Paper to be read with a view to discussion: —"Accidents in Mines," Part II., by Sir F. A. Abel, C.B., F.R.S., Hon. M. Inst. C.E. Friday, November 18th, at 7.30 p.m.: Students' meeting. Paper to be read:—"Boiler Experiments and Fuel Economy," by John Holliday, Stud. Inst. C.E.; Mr. William Anderson, Member of Council, in the chair.

Liverpool Engineering Society.—A special general meeting of the members of the Society will be held in the small Lecture Room of the Royal Institution, Colquitt-street, on Wednesday, November 16th, at half-past seven o'clock, for the purpose of considering the recommendation of the Council that the latter part of Rule I. read as follows:—"Students shall be persons under twenty-one years of age, in course of training to become engineers. They shall have all the privileges of ordinary membership except the right to vote." At the conclusion of the special meeting, of which notice has been given, the thirteenth meeting of the thirteenth session will be held. (1) Minutes. (2) Miscellaneous communications. (3) Paper by Mr. R. Lethbridge Tapscott, entitled "A Short Railway Journey in India," will be read.

Chemical Society.—Thursday, November 17th, at 8 p.m. Ballot for the election of Fellows. Paper to be read:—"On the Halogen Substituted Derivatives of Benzalmalonic Acid," by Chas. M. Stuart, M.A.

Meteorological Society.—Wednesday, 16th inst., at 7 p.m., by permission of the Council of the Institution of Civil Engineers, at 25, Great George-street, Westminster: Ordinary meeting. Papers to be read:—"The Use of the Spectroscope as an Hygrometer Simplified and Explained," by Frederic W. Cory, M.R.C.S., F.R. Met. Soc.; "Rainfall on and around Table Mountain, Cape Town, Cape Colony," by John G. Gamble, M.A., M. Inst. C.E., F.R. Met. Soc.; "On the Cause of the Diurnal Oscillation of the Barometer," by Robert Lawson, LL.D., Inspector-General of Hospitals.

Society of Architects.—A special general meeting of this Society wlli be held at St. James' Hall, Piccadilly, W., on Tuesday, November 15th, at 7 p.m., to confirm the addition of the following rule to the rules of the Society, viz., "The title of this Society shall be "The Society of Architects.'" This meeting will be followed by the first ordinary meeting of the Society for the Session 1887-8, when the balance sheet will be presented, and the president, Mr. Joseph J. Lish (Newcastle-on-Tyne), will deliver the opening address of the session.

North-east Coast Institution of Engineers and Shipbuilders.—The second general meeting of this Institution will be held in the Lecture Hall of the Subscription Library, Fawcett-street, Sunderland, on Wednesday, November 16th, at 7.30 p.m., instead of 9th inst., as previously arranged. Papers to be read and discussed:—"The Influence of Coal Consumption on the Commercial Efficiency and the Design of Cargo Steamers," by Robert Thompson; "Notes on Steamship Speed Calculations," by G. N. Arnison, jun.

DEATH.

On September 22nd, at St. Thomas, West Indies, suddenly, after a few days' illness, while on professional duty, Charles Campbell Downes, C.E. Foreign papers, please copy.

THE ENGINEER.

NOVEMBER 11, 1887.

ADDRESS OF THE PRESIDENT OF THE INSTITUTION OF CIVIL ENGINEERS.

A review of the salient features of the history of the past fifty years has been so generally the subject of presidential addresses during this year, that a wish that some subject more of the day and of the future might be chosen would in most cases be excusable. The wish would not, however, arise with reference to the address of the President of the Institution of Civil Engineers, for the history of the years of the Queen's reign has been so largely made by the profession of which the Institution is the head centre, that the subject is peculiarly that which the President could most advantageously select. The only objection to it is the impossibility of treating it adequately within the space of an address, for the civil, or civilian engineer, claims as part of his profession all the mechanical and structural arts that have specially been the means of the unparalleled advances which mark these fifty years of the world's progress, and exceed in brilliancy of results any half century within the known history of things which affect the comfort and well-being of mankind.

Mr. Bruce succeeded, however, in retaining the interested attention of his hearers on Tuesday evening, partly by the pride which engineers feel in the advances to which he referred, and partly by the excellent style in which the address was delivered. In the first instance, he naturally referred to the increase in the numbers of the members of the Institution as some index of the growth of the work of the engineer and of the great material influence of the results of his works. In June, 1837, there were 238 members of all classes: in June, 1887, there were 5396 of all classes, and the income of the Institution was respectively £713 and £21,015. These numbers include, however, but a portion of those engaged in various branches of the widely embracing profession of the civilian engineer, most of whom are occupied in increasing the means of transport, of communication, of the more economic production of the requirements of the greater part of the world's population, or of providing for or improving the hygienic conditions of its life. The enormous extension of the influence of the engineer is moreover shown by the flourishing condition of the societies kindred to the Institution, and devoting special attention to parts of the work included in that of the Institution.

Mr. Bruce commenced his professional career in the works of Robert Stephenson, in Newcastle, early in 1837, and was thus able to draw from his own experience most interesting comparisons of the ways and means of an engineer's workshop then and now; and as will be found on page 391, few things are more remarkable than the facts given in this comparison, unless it be the admiration which everyone must feel for the men of those days who could accomplish so much with so little mechanical assistance. It is particularly worthy of attention that with the growth of the mechanical means of performing work, the payment of mechanics has steadily increased and the hours of labour decreased, and to such an extent that the wages per hour are now 57 per cent. greater than in 1837. Concerning British trade abroad, Mr. Bruce remarks:—"We are constantly told that the difficulty Britain has in holding its own in the markets of the world is due to our want of technical education. There is something in this, but in my judgment comparatively little. The true cause of the difficulties is the large increase in wages and diminution in the hours of labour. It would be pleasant to think that this was not so, but I have not the shadow of a doubt that it is the main trouble in meeting foreign competition." Mr. Bruce's opinion on this subject is of importance, and when he says there is comparatively little in the supposed effect of the presumed absence of technical education, he, of course, means that this is so as regards the wage-earning classes. The want of technical education, combined with lack of knowledge of modern languages and commercial tact on the part of manufacturers and those who represent them abroad, is another matter.

In dealing with public works, Mr. Bruce paid special attention to the superiority of modern methods, chiefly due to the extensive use of iron and steel and of Portland cement concrete, and he might have added to the mechanical methods of procedure aided to an almost unlimited extent by mechanical appliances. He dwelt particularly on the modern methods of sinking piers for bridges, and especially on the old Indian method, which has been applied of recent years on so large a scale by the aid of machinery, the most remarkable example being the caisson which embraced a whole dock, and was 472ft. in length, 134ft. wide, and 62ft. in depth. It would be interesting to trace back the development of the invention of the machinery employed in making this work possible, including the compressed air and diving machinery.

There are few engineers who will disagree with Mr. Bruce concerning modern steel and iron bridges, and the neglect of the arch form in favour of girders. The "graceful and time-honoured arch has largely given way to a substitute which has neither grace nor beauty about it." Many will also agree that, except where physical conditions render the use of the girder or metallic arch essential, that stone or brickwork arches should be used as superior in appearance and durability; but there are more who will favour the use of the artificial product. Mr. Bruce asks, "Where would the works of past centuries have been now had they been of iron?" But it would be replied with respect to a great deal of the iron structural work of to-day that it is not built for future centuries, and that even if it would last for centuries, it would be useless at the end of one, simply through changes in social, political, or commercial requirements, to say nothing of the end arrived at by comparatively cheap iron structures that could not be if masonry had to be employed. Everyone will, however, entirely agree that for public roadways and for railways in settled countries "engineers would do well to retrace their steps, and not use flat iron girders where a brick or stone arch is admissible."

On the manufacture of iron and steel Mr. Bruce spoke at length, and especially of the results of the labours of Bessemer, Neilson, Siemens, Cowper, and others, which have brought steel from £60 to £6 per ton, and pig iron to about half its cost in 1837. This brought him to the enormous strides in marine architecture and engineering which have followed the metallurgical developments, touching especially upon the increase in the size and speed and comfort of ships, and the great strides made in the construction of marine engines and boilers. Few things indeed are more remarkable than the developments which have become possible in these directions as a result of the metallurgical achievements of a comparatively short period.

Not much less remarkable than in other directions has been the engineer's work under the comprehensive head, sanitary engineering, of which a good deal was said in a short space. Hydraulic machinery as a modern servant-of-all-work necessarily claimed notice, and electricity in some of its more modern applications he reviewed with much hopeful expression of probable developments in electric locomotion. In his conclusion, Mr. Bruce gave his reasons for refraining from treating of instruments of war, whether of guns or ships. Whether for the same, or for other reasons, this is a course which might be sometimes recommended, for it has not been much to the advantage of any one to hear a tyro descant on such special matters.

Mr. Bruce was, as we have said, deservedly listened to with great interest, and possibly the necessary adoption of a Jubilee subject did not materially lessen the value of the address; but we may take this opportunity to say that it ought not to be too much to expect from the leaders of a profession some carefully thought-out glimpses into the probable future, some useful deductions from a long and special experience, some strong guiding light, rather than the *rechauffé* which is the resource of the mediocre.

TECHNICAL EDUCATION.

Perhaps we owe an apology to our readers for once more addressing them on the subject of technical education. Our excuse is simply that we cannot help dealing with the subject. It is thrust upon us. We feel that we should not do our duty if we did not protest against the spreading of erroneous views by influential people. There is in existence a turbulent minority who will insist on setting forth their opinions on technical education; and this minority must be combated and defeated, or a great mistake will be made, a serious wrong perpetrated. It is a most unfortunate circumstance that if a man once makes a reputation for himself as an orator, a statesman, or a teacher, he will be subsequently held by large masses of people to be pretty nearly infallible all round. If, for example, a man is known to be a successful diplomatist, it is assumed that all that he says about art must be worth listening to, and so on. In this way, and in no other, can we explain the credence which is given to the utterances of the numerous advocates of technical education who are now, to use a political phrase, "stumping the country." *Ex uno disce omnes.* When we have heard one we have heard all. In every case we have two subjects dealt with. The first is foreign competition; the second is technical education as a cure for foreign competition. Sometimes we are told about the competition first, and the technical education afterwards. In other cases variety is introduced by dwelling first on the beauties of technical education, while foreign competition is brought in subsequently. Whatever the arrangement, however, the materials are the same. Now-a-days, if we hear technical education spoken of, we may be certain that unless the speaker is suddenly taken ill, or the gas goes out, we shall have foreign competition before he is done. The most recent instance of this kind of thing is supplied by Lord Derby's speech at Crewe on the 7th inst. In another page will be found an abstract of his speech. Here is one passage from it:—"As to one part of your business, technical instruction, there is now only a single opinion. We are harder pressed than ever we were before by the competition of foreign artisans and workmen, and even if we were to fall back on the lazy expedient of trying to protect our native industry by the old method of restrictive or prohibitive tariffs, which I don't think we are likely to do yet, that would only help us where the home market is concerned; it would be useless as regards our export trade. We are fighting for the markets of the world. We have held our own hitherto, but the struggle is sharper than ever, and we cannot afford to throw away any advantage which is possessed by other countries." If Lord Derby had been an ordinary speaker, he would have stopped here. But he is not an ordinary man. On the contrary, he is an extraordinarily shrewd man in certain respects; and so he went on: "It may be that, as often happens, we shall find that we have over-rated the benefit of technical teaching—that it can do less for us than we now expect; but we are at least bound to try to deserve success, whether we get it or not."

One of the worst features about the technical education movement is that no one seems to know what it really means, or what it is intended to do. Lord Derby's utterances, for example, are simply exasperating in their vagueness. He told his hearers, the delegates of the Lancashire and Cheshire Institutes, that technical education might render protective tariffs unnecessary. He forgot to call attention to the fact that each and all of those trade competitors who are so dangerous because of the technical instruction given in their schools, has found it imperatively necessary to adopt high protective tariffs to keep English goods out. Why should technical education do more for us than it has done for Germany? It has not raised wages in that country; it has not reduced the hours of labour. Why should it do either for the working man here? It is, we know, vain to ask such questions, for no one will answer them. No one will formulate anything about the subject or do more than repeat the parrot cry, "Give us technical education that we may beat the foreigner." We shall not ask questions, we shall make statements, put forth propositions, assert truths plainly. Technical education is like all other education—of no value in itself. It is simply the means to an end; it is a tool, and to those who do not want the tool it is of no possible value. We knew a man once who prided himself on his ability as a joiner. As a matter of fact, he was, even for an amateur, perhaps the very worst and most incompetent joiner that ever existed. He had a special craze, a love for moulding planes, which was all-devouring. He bought them right and left, and his collection included, we suppose, every variety of moulding plane produced. They were all of the best and most expensive make, walnut and ebony, and brass and steel. Of these planes he could make no intelligent use, but they were conspicuously set forth on racks. Now technical education may very easily take the place in a great many minds of the moulding planes to which we have referred. There are men to whom it is not only useful—it is quite indispensable. Such men are managers of works, locomotive superintendents, railway engineers, &c. &c. Foremen, too, require technical education very varied and extensive, but not of the same character. Every artisan must possess technical education; but this, again, differs in nature and amount from that of the foreman or works manager. The technical educationalist would have all taught alike, and, what is worse, he would have all taught at the cost of the ratepayers. We have said a hundred times, and we repeat, that we are not opposed to the spread of technical education. But we do not attach the popular meaning to it. We would have every man carefully fitted by education for the performance of the work which he intends to do. To teach a plumber to make a joint in which there shall really be more solder than resin, is to technically educate him; to instruct a fitter so to shape and fit keys in their seats that they may not fall out or require to be wedged in with bits of tin, is to technically educate him to some purpose; but we cannot see that the plumber would make better joints because he has been taught the Binomial Theorem; nor can we see that wheels would be better keyed on their shafts because the fitter perfectly understood the chemistry of the sun. The trades unions do their best to limit the number of apprentices. So long as their practices in this direction are not illegal we have nothing to say against them. It is quite natural that they should endeavour to keep down the supply of labour, and so keep up wages. Whether it is wise is quite another question, with which we need not concern ourselves; but we have no hesitation in asserting that to limit the amount of teaching given to the apprentice is not only fraudulent but imprudent to the last degree. The technical education man asserts that apprenticeship, as a system, is dying out, and that the technical school must take its place. Perhaps so; but no scheme of a school which can be its substitute has ever been formulated. When such a scheme is prepared we may be able to speak well of it, but there is nothing of the kind available for criticism just now.

The training to be had in school or college can only be of value to those who have to use their heads in after life more—very much more—than their hands. But there is no reason why the ratepayers should defray the cost of educating men of this class. As a rule they must be comparatively limited in number, and their parents are quite competent to pay school or college fees. The technical education of the British workman is best obtained in the shops; indeed, it cannot be obtained anywhere else. Furthermore, if there is really ability for headwork in any artisan, he will assuredly come to the top; and there are abundant facilities open to all such now in London and our great towns for saturating themselves with technical education. But technical education will not enable us to compete with Germans or any other competitors who work harder, and for longer hours, for less wages than we do.

THE CALORIFIC VALUE OF COAL.

In our last impression will be found two very interesting letters on the calorific value of coal, by Mr. Goodman and Mr. Bower. It will be remembered that in a recent impression we directed attention to statements frequently made concerning the economic efficiency of steam boilers, setting forth results which are inconsistent with what is assumed to be accurately known concerning the thermal value of coal. We pointed out that some of these statements were made by men whose competence as experimenters, information as engineers, and honesty as investigators were above suspicion; and we said that the facts led us to believe that the text-book utterances concerning the thermal value of coal possibly required revision. The communications of Mr. Bower and Mr. Goodman fortunately take different aspects of the whole question. Mr. Goodman deals with the practice of carrying out calorimeter tests, while Mr. Bower brings before our readers an explanation of the phenomena of combustion which cannot be read without interest. It is to be hoped that questions of so much importance will not be allowed to drop, but that they will continue to be discussed until some useful result has been attained. Under the circumstances, we make no apology for further opening the ground.

We have already said that the results of calorimeter tests made in the laboratory may be unsatisfactory because, for one thing, of the smallness of the quantities of fuel consumed, and it will be seen that Mr. Goodman, as a practical analyst, endorses much that we have said. On one point he might have written more fully than he has done, namely, the hydrogen. The calorific value of pure carbon is put down at 14,500 units per pound, and it is a very common practice to regard coal as pure carbon, although it is never anything of the kind, even in the anthracite regions; and bituminous coal is a very composite material. Many years ago Mr. Joseph Hume, M.P., induced the Admiralty to make a series of experiments to ascertain the heating value and composition of various coals. The experiments were carried out by Dr. Playfair and Sir Henry de la Beche, and large tables were prepared from those experiments, which are still regarded as standards. We learn from these tables that Llangennech coal, with which many of our readers are no doubt familiar as that which was always used by the Royal Agricultural Society in testing engines until the present year, contains 85·46 per cent. of carbon, 4·20 per cent. of hydrogen, 1·07 of nitrogen, 0·29 of sulphur, 2·44 of oxygen, and 6·54 per cent. of ash. Now, according to theory, the calorific value of 100 lb. of this coal, neglecting the sulphur, is 85·46 × 14,500 for the carbon = 1,239,170 units, and for the hydrogen 4·2 × 62,000 = 260,400 units, or in all 1,499,570 units. The theoretical value of this coal is put down as = 14·260 lb. of water, converted into steam from and at 212 deg. This is equivalent to 966 × 14·260, or 13,775 units per pound, or for 100 lb. 1,377,500. Let us take again Dalkeith Coronation, a Scotch bituminous coal, and compare it with the Welsh non-bituminous, Llangennech. Its composition is given as: Carbon, 76·94; hydrogen, 5·2; sulphur, 0·38; oxygen, 14·37; ash, 3·10. We have, then, for 100 lb. of coal, for the carbon, 76·94 × 14,500 = 1,115,630 units, and for the hydrogen, 5·2 × 62,000 = 322,400, or in all, 1,438,030 units. The total number of pounds of water which can be converted into steam by a pound of this coal is set down as 12·77, and 12·77 × 966 = 12,335·82 units per pound of coal, or for 100 lb., 1,233,582. Our principal object, however, in reproducing these figures has been to show that the hydrogen contained in coal plays a very important part.

Now it has long been a moot point with chemists as to how this hydrogen should be regarded. Is it to be looked on as free hydrogen available for combustion altogether, or is it already in combination with oxygen in the form of water, or with carbon in the form of a hydrocarbon? We are not aware that any decided answer has yet been given to the question, but more hangs on it than appears at first sight. We must not assume that under the conditions obtained in a steam boiler furnace the hydrogen of the coal will turn at once to water when in the presence of air; Dulong and Despretz have laid it down that when hydrogen and oxygen exist in a compound in the proper proportion to form water—that is by weight one of hydrogen to eight of oxygen—these constituents have no effect on the total heat of combustion, and Rankine gives the total evaporative efficiency of 1 lb. of combustible in thermal units, as—

$$E = \frac{h}{966} = 15 \left\{ C + 4{\cdot}28 \left(H - \frac{O}{8} \right) \right\}$$

As to calorimeter experiments on carbon, there is no agreement among the results of the principal chemists, Dulong gives its thermal value as 12,906, Despretz as 14,040, and Favre and Silbermann as 14,500. The highest is now always accepted as nearest the truth, but we have reason to think it is not high enough. The value of the hydrocarbons in any fuel is largely affected by the way in which combustion is carried on; with insufficient admission of air all the hydrocarbons will be wasted. Marsh gas, H_2C, is produced, and for every 1 lb. of hydrogen wasted 3 lb. of carbon are also wasted; while if the combination assumes the form H_2C_2—olefiant gas—then for every pound of hydrogen wasted 6 lb. of carbon are also wasted. As an example of the modern method of dealing with the calorific value of coal, we cannot do better than cite Mr. Stead's calculations of the value of the Powells Duffryn coal used during the Newcastle trials. Mr. Stead found that the coal contained carbon 88 per cent., hydrogen 3·65 per cent., of which 0·32 per cent. was combined with oxygen, of which there was 2·53 per cent., making with the hydrogen 2·87 per cent. H_2O; nitrogen, 0·64 per cent.; sulphur, 0·76 per cent.; ash, 3·17 per cent.; and moisture, 0·83 per cent. The calorific value of this in thermal units he gives as carbon ·884 × 14,544 = 12,856 units; hydrogen, ·0333 × 61,200 = 2037 units; and sulphur in the form of pyrites estimated at 47 units, or in all 14,940 units, which is not very far from that of Llangennech quoted above. It will be seen that Mr. Stead takes different values for both carbon and hydrogen from those given in most text-books.

Mr. Bower's letter deals, it will be seen, with the important question of dissociation, and goes to show that a furnace may be too hot for economy. This is, in certain respects, a novel application of an old theory to a new purpose, but we are disposed to doubt that any temperature sufficiently high to prevent combination exists in a steam boiler furnace. We cannot, however, attempt to criticise, one way or the other, the views advanced by Mr. Bower until he formulates them more fully than he has done. If he will trace the whole process of combustion in a fire-brick furnace, and compare it with the various steps of combustion in a locomotive fire-box, let us say, he will supply a useful contribution to this discussion. After all, however, we believe that the crucial points in the whole matter are the influence of radiant heat, and the influence on radiation of the smoke or gases within the furnace or flues. We are not aware that any experiments on a large scale have ever been carried out on radiation, save those dealing with the sun's rays. In the past, vessels filled with hot water and coated with different materials have formed the principal subject of experiment. The whole phenomena of radiant heat is still wrapped in much mystery. Dr. Siemens, with his new radiating furnace, is apparently among the first to start a new line of inquiry, which may lead to important results. We may ask, however, whether it is or is not a fact that different results as to the total heat to be got out of a given sample of fuel may be obtained, as it is or is not so burned that it has an opportunity of radiating heat at a high temperature. It is, we fear, too much the custom to take things for granted in certain directions, and among others, it is assumed that no matter how a given combustible is burned, the total available heat, other things being equal, will be the same. This is, we think, taking too much as proved in the present state of physical science, and its accuracy ought to be demonstrated before it is asserted that it is demonstrable.

PUBLIC WORKS DEPARTMENT OF INDIA.

For very many years past the civil engineers employed in the Department of Public Works throughout India have made their position, relatively to that of military men employed in the same service, the subject of what has been acknowledged to be well-grounded complaint. We do not say that efforts have not been made in the direction of removing the causes for the disaffection felt; but they have not, according to all accounts, succeeded to the extent the gravity of the complaint demanded. Of late it must be admitted that the adjustments effected seem to have removed the heavier disabilities to which the civil engineer, as compared with his military co-worker, was subjected. At all events, we have heard but little during the last year or two of any grumbling on the part of the civilian *employés* of the department. But a recent step taken by the Government of India appears to be likely to awake anew those feelings of jealousy and dissatisfaction which, so long as cause for them is given, must militate most seriously against the efficient working of the department. Unless all connected with it act harmoniously, it is impossible that the full results expected of a public service can be attained. Only as recently as September 26th of the present year, the Indian *Gazette* contained a notification that the Government had decided on a resolution which embodied the following rule: "Any civil engineer of the Public Works Department who, on reaching the age of fifty years, has not attained the rank of superintendent engineer, will be liable to be called upon to retire." Sundry provisions follow this announcement limiting its operation in the case of men of twenty and twenty-five years' service, but they do not touch the general question by which men in the prime of life may be arbitrarily removed from a public service. With the grounds upon which the above resolution has been taken we are unacquainted. They should certainly be of the strongest nature to lead to the setting aside of claims of length of service. Those acquainted with the working of the Public Works Department in India assert that promotion in it is as often as not due more to partiality than to the recognition of exceptional ability. Whether this, however, be the fact or not, it seems natural to conclude that in a service, entrance to which can only be obtained by proved capacity, that capacity should entitle to regular promotion. If incapacity be afterwards proved as a bar to such promotion, why, we would ask, should inefficient men be retained till twenty-five years of service have passed? The permission for such a term to be realised must be held a warranty for efficiency. To arbitrarily terminate service at that term because from many imaginable causes promotion has been slack, is a measure so objectionable in its essence as to demand for the profession we represent the fullest explanation. As to the treatment on the same lines which the *Gazette* quoted assigns to military men in the Department, such lines carry no parallel. Such men have their military rank and emoluments to fall back upon, while the civilian, at an age when it must be most difficult to enter upon other employment, and yet one at which good work is still possible, is to be forced to retirement—upon a pension, it may be admitted, but one of an amount scarcely likely to compensate for the loss of active employment and its adequate remuneration. We hold therefore that the determination of the Indian Government requires to have its reasons fully laid before the profession and the public.

COPPER AND ITS PRICE.

The rise in the price of some metals has, during the last week or two, been abnormal in its character and in its rapidity, but it is not too soon to be needed to revive industries which have been drooping. In the olden days, Cornwall was the chief source of production; but Australia, Spain, and America have entered into the arena, and the output of England has declined relatively and actually. In the "brisk" days of 1872, the price of Chili bars was as high as £108, and the comparison of this with the price of £40, which was common up to a few weeks ago, will indicate the extent of the decrease in the price of copper. From that price it has risen with irregular jumps of a few shillings to a pound or so per ton daily, and now the excitement in the trade is such that it is rather difficult to define the extent to which the upward bound may lead. For five years the price of copper has been decreasing; and, whilst the decrease occurred, consumers have held off, stocks in the chief centres have declined, and buying is from hand to mouth, whilst there inevitably followed the closing of some of the mines, which, from position or other causes, could not be worked so economically as others. The consequence is that the market has been caught bare of stocks, and when the impulse has once been given it has been very rapid in movement and effect. And, what is not so usual, there has been a movement almost concurrent in the market price of the crude and the finished article. This increase in the price may lead to an increase in the production in this country—indeed, it should do so—but the copper trade has been deluged of late years with foreign copper. In 1850 England produced over 11,000 tons, and the United States only 7000 tons; but in the year 1884 the positions were not only reversed, but the production had sunk in this country to 3000 tons, whilst that of the United States had risen to over 60,000 tons. Chili, in the two years indicated, raised its output from 14,000 tons to 41,000 tons; and Spain, which practically produced nothing at the earlier date, yielded 40,000 tons at the later. Australia sent out eight times as much; and without further details, it may be said that whilst in the first of these years England was second in the ranks of the producing nations, in the latter it had sunk to the tenth position. In the later years there has been a continuation of that change, under the decrease in price; and now that there is that increase in the price, it is to be expected that the sources of production will be enlarged along a good portion of the line of the world's output. That increase cannot be immediate; and thus the first effect of the increase of price must be to diminish the visible stocks by making consumers lay in more from the great centres of stock at Swansea, Liverpool, and other points; but in time the mines will be made to yield more, and thus the increase in prices will be held in check. It is to be noticed that there is with that increase in price a rapid rise in the value of the shares of some of the copper companies; and there are other indications that capitalists expect the increase in value to be to some extent permanent; and those who know the importance of this old mining industry to some parts of Britain will wish that the revival may be not only enduring, but extending to allied industries.

BRAKES ON FREIGHT TRAINS.

It will be remembered that important brake trials were made last April at Burlington, U.S.A., with a view of adopting such safety appliances for long freight trains. All the present systems of air-pressure brakes were represented. The trials took place on a train of fifty cars. It was found that on account of the time taken to brake the rear cars, such shocks were experienced that not only would the freight suffer great damage, but that the cars themselves were disabled. Indeed, doubts were raised in the minds of the railway representatives as to whether air brakes could be used at all on such trains, and some went so far as to say that the difficulty could only be got over by calling in the aid of electricity to make the action of the brakes simultaneous. Mr. Westinghouse contended at the time that to use this agent would be to make the brakes dangerous by beingless trustworthy. He said that by modifying the triple valve he could quicken the action of the brake to such an extent as to dispense with electricity. We read further and detailed accounts in the American papers which have just arrived of the remarkable results obtained by the new freight train brake, as perfected by Mr. Westinghouse. The leading engineers of the principal railways of America have had the opportunity of judging the practical value of this important railway invention. It is now shown that a freight train of the unusual length of 2000ft. can be as safely handled, regarding its brake power, as passenger trains of shorter length have been, and are up to and at the present time. In emergency stops this new form of brake comes to the front, for to stop a train of such length in 125 yards from a speed of 38 miles per hour in 12 seconds without any shock or jolt whatever, is no poor performance. Mr. Westinghouse has thus exploded the theory that no air brake would be practicable on such a long train without calling in the aid of electricity. The triple-valve so modified as to meet the necessity of the case is really the instrument which does so much in so little time—the difference of time in which the brake is applied on the first and last car—in a train of fifty cars—is only 1⅜ seconds, *i.e.*, practically instantaneous. It is somewhat assuring that in these days of quick transit valuable life and property can be efficiently protected from the still too often occurring railway accidents.

AN OPENING FOR BRITISH TRADE AT CANTON.

The British Consul at Canton reports that there is a good opening for tradesmen settling there and supplying the native retail purchasers, and that more money could be made in that way than in the established grooves. Such an enterprise requires much courage, endurance, energy, and perseverance. The consul is either a grim humourist or does not share the opinion so generally expressed by many of his colleagues as to the apathy and indifference displayed by his countrymen in suiting the tastes and wants of foreigners. He admits that the life in Chinese towns would be unpleasant for the following reasons:—The shops must be situated in the native quarter, insurance at first will be impossible, they will be exposed to the dangers of arson and robbery; every shop containing anything of value is barricaded at dusk so that it can stand a siege, guards are necessary at every corner, and half the streets are closed at night by gates only to be forced by artillery. A passage-boat conveying passengers to places fifty miles distant from the capital of the province requires from twelve to fourteen cannon. A journey of a few miles away requires an armoury of muskets and swords. By making the carrying of arms without a license a capital offence, by authorising the patrols to shoot anyone they see on the housetops at night, by maintaining constant patrols, and scouring the creeks with armed steam launches, piracy and highway robbery have to some extent been diminished, but are very far from being at an end.

LITERATURE.

The Metallurgy of Silver, Gold, and Mercury in the United States. By T. Egleston. Vol. I.—Silver. 8vo, pp. 558. London and New York. 1887.

This is the first of a series of volumes dealing with the development of metallurgical processes for the treatment of the ores of the precious metals in the Western States and territories of North America, which have been in preparation for some years past. The author, who is the Professor of Metallurgy in the School of Mines of Columbia College, New York, is well known as a voluminous and painstaking writer upon metallurgical subjects, and many interesting and valuable memoirs upon special processes have been contributed by him to the "Transactions" of the Institute of Mining Engineers and other technical journals both in America and Europe. Several of these memoirs are included in the present volume, which is essentially a collection of essays upon the working details of processes as carried out at different places in the United States, rather than a systematic treatise on the reduction of silver ores. The subjects are classified into ten chapters in the following order:—"Sampling," "Zinc Desilverising," "Ziervogel's Process," "Crushing Machinery," "Roasting Silver Ores," "Patio and Cazo Amalgamation," "Barrel Amalgamation in Colorado," "Pan Amalgamation," "Treatment of Tailings and Hyposulphite Extraction Processes," in addition to which there is an introduction covering sixty pages, giving a condensed history of the origin and progress of gold and silver mining, and statistics of production of the precious metals up to 1884. The most valuable portions of the work are those devoted to pan amalgamation and the treatment of tailings in Chapters VIII. and IX., the latter especially containing much interesting information on the working of the tailings from silver ores containing lead at Tombstone in Arizona, by a method developed by Mr. J. A. Church between 1881 and 1884. There is also a notice of the practice of combined amalgamation and concentration used by the Montana Mining Company, which probably represents the latest modification in the practice of silver ore reduction in the Rocky Mountain district. In connection with this part of the subject we find several allusions to the Boss process of continuous amalgamation, but although there are references in the index, we have not been able to find the process described. The final chapter on extraction by hyposulphites contains good accounts both of the original process of Von Patera as practised in America, and of the newer modification due to Mr. E. H. Russell, of Utah, who uses a solution of sodium and copper hyposulphite as an extracting agent after the sodium salt has taken out all the silver that it is competent to dissolve in a first washing. This extra solution has a powerful decomposing and solvent action upon sulphides containing silver, and has the advantage of dispensing with roasting as a preliminary to extraction. It appears from the author's statements to have been successfully adopted at the Ontario Mill in Utah, and at Bullionville, Nevada.

The earlier chapters, though containing matter of interest, are of less value than the final ones. The description of the Boston and Colorado smelting works at Black Hawk, which were removed to Denver in 1878, refers apparently to about 1874, but by a judicious confusion of "was" and "is" in the text, the old account is made to do duty for the present time, and the result is decidedly misleading in many particulars. The article on zinc desilverising is a mere fragment, as neither the original smelting of the ores nor the refining of the enriched lead are noticed in any detail. It would, for instance, have been very desirable to have more information as to the use of Portland cement instead of bone-ash as a material for refining tests than has been given on page 110.

From the dedication of the volume we learn that the author is a former student of the Ecole des Mines, of Paris, which may account for his partiality to Gallicisms, such terms as "crasses" and "cupelle" being used for the more familiar English dross or skimmings and test. He also seriously purposes to substitute the French "chloruration" for chloridising. Another, and less agreeable, French peculiarity is the carelessness with which proper names are given. Thus, the late Mr. Hugh Lee Pattinson is called indifferently, Patterson and Patinson; the Augustin process is everywhere called Augustine, and the process of zinc desilverisation is said to have been reinvented by Crooks, in England, in 1858; although in Europe it is generally supposed to have been invented by Alexander Parkes, of Birmingham, in 1850, and to have been set to work shortly afterwards. If the evidence concerning matters of comparatively recent occurrence can be distorted in this fashion, we should be indisposed to accept the author's statement that, "To-day a more thorough knowledge of these sciences—mining and metallurgy—can be had here—in the Educational Institutes of the United States—than anywhere else," if metallurgical history is supposed to be included in such knowledge.

Iron Bridges of Moderate Span: their Construction and Erection. By Hamilton Weldon Pendred. Weale's Series. London: Crosby Lockwood and Co. 1887.

In most books upon bridges the authors concern themselves chiefly with what may be called the mathematical and physical questions that relate to the determination of the stresses, dimensions, weight, and strength of various forms of bridge structures. In this book the author assumes this information to be already in possession of those who require it, and he takes up the subject from the workshop, girder-yard and site point of view, duly, however, insisting upon the necessity for the careful preparation of really practical drawings fully dimensioned, and describing the losses which occur in the works through the issue of hurriedly prepared and incomplete drawings. The drawings being finished, he follows them through the works, yard, and to the site of the bridge, and does not leave until the bridge is completed. The work thus described includes the setting out of the work, attention to the work in the several stages, bending plates and bars, arranging for camber, temporary connection, and rivetting up; treatment of different lengths of rivets, moving main girders, setting up the top boom, connecting parts, and setting cross girders, and completing the floors and roadways. To the chapters relating to the way in which all this work is started and executed, are chapters on sections of iron, influence of temperature, duties of an inspector, on specifications, and on rivetting, and an appendix gives a complete specification for the construction, erection, and completion of a lattice girder bridge.

The book thus deals entirely with the questions which occur to any one desiring to know how to set to work about constructing and erecting a bridge when the drawings are made, and the questions which would occur to an inspector of bridgework in construction.

In treating of the influence of the change of temperature, a paper by Mr. Graham Smith is quoted, in which it is made to appear that the mechanical equivalent of expansion or contraction by change of temperature is brought to bear generally in bridge structures, whereas a large range of temperature may impose no increased stresses whatever on such a structure. In another edition of the book many of the central pages would be the better for more engravings, and the buckled plate shown at Fig. 14 needs correction as to form. The meaning of the following sentence at page 3 may be understood, but it is at least doubtful:—"Colours ought to be used more generally than is too often the case at present."

Exercises on Quantitative Chemical Analysis; with a short Treatise on Gas Analysis. By W. Dittmar, LL.D., F.R.S. 8vo.; pp. 318. Glasgow: W. Hodge and Co. 1887.

The author, who is well known as an accomplished analytical chemist, and by his researches into the variations of composition in sea-water from different parts of the world—which form part of the report of the Challenger Expedition—here presents us with the result of his experience as a teacher in the Andersonian Laboratory at Glasgow. It may, of course, be thought that the numerous books previously published on similar subjects left little room for a new one; but even a superficial investigation shows that there is still space for a considerable amount of originality in laboratory practice. The author is especially careful to insist upon the beginner being well grounded in the technicalities of the subject, and the earlier exercises in the book enter very minutely into the details of the simple but fundamental operations of the laboratory, as he holds that there is "no fear of any talented student being spoiled by a course of judicious drilling." This is a somewhat welcome variation from the denunciations of analysis which have been lately fashionable among high theorists, whose avowed aim is to make chemical philosophers rather than chemists of their students, without regard to the circumstance that the demand for the former article is likely to be more severely limited than for the latter. The examples selected cover most of the useful problems likely to arise in practice, and the methods selected are for the most part excellent. We are inclined, however, to differ from him in his estimation of Liebig's method of separating nickel and cobalt "as merely of historical interest." When properly handled, and with scrupulously pure reagents, it is one of the most certain and satisfactory processes known. The section on cupellative assays is not of much value, and might have been omitted without loss to the book. The section on gas analysis is exceedingly good, and brings the subject up to the newest practice; and that on the analysis gives the methods adopted in the Challenger investigation. Taken as a whole, the book is very valuable, and should prove widely useful.

LIQUID FUEL ON THE THAMES.

For some time past Mr. E. N. Henwood has been experimenting on the Thames with his launch, the Ruby, with liquid fuel. The combustible he uses is known as "green oil." It is obtained from gasworks, and has practically no flashing point. It seems, indeed, to be not much more inflammable than Colza oil, in which respect it differs considerably from petroleum. The boat has run continuously for sixty miles without showing the least smoke. The Ruby is 38ft. long over all by 7ft. beam and 3½ft. draught of water. The engine has a single cylinder 7in. in diameter by 8in. stroke; the boiler is of the marine return-tubular type, 6ft. long and 4½ft. diameter, with 200 square feet of heating-surface and 7½ square feet of grate surface, designed to supply steam at 100 lb. pressure, and built according to Lloyd's requirements. When fired by coal and with the ordinary exhaust up the funnel, it will drive the engine at 240 revolutions per minute.

A trial of the Ruby was made in June last, the boiler being fired with Welsh coal, with the following results:—

Mean speed with and against tide on Long Reach measured mile	7·2 knots
Mean revolutions per minute	246
Mean working pressure	100 lb.
Mean indicated horse-power	20
Consumption of coal per hour	140 lb.
Price per ton	20s.
Quantity of fuel carried (say nine hours' supply)	12 cwt.

The fire-bars were then taken out, and the furnace and appliances according to Henwood's patent fitted. The furnace is built of firebrick, within the flue, and is so constructed as to enable complete combustion to be effected. The oil is blown into the furnace by superheated steam through a novel form of injector, recently patented by Mr. Henwood, in order to get rid of the intolerable noise usually made by the combustion of liquid fuel. To a large extent the combustion has been silenced on board the Ruby. Mr. Henwood claims to have placed his invention before the public in a practical form, and to have tested its trustworthiness, and to have obtained a better result than has been obtained by any other plan, the consumption of fuel being less than half that of a coal-fired boiler; and it is only reasonable to maintain that a corresponding reduction of fuel would result in a compound or triple-expansion engine.

There is no great amount of steam required for spraying the liquid fuel, and it is by no means a serious matter, as it is customary in large steamers to provide a fresh-water condenser to make up for the incidental condensation and leakage of steam, and such supply will only need to be increased. Another advantage claimed is that the fire can be shut off at six p.m. with 85 lb. of steam in the boiler, and twelve hours after there will be from 15 lb. to 20 lb. of steam left, which is ample to relight the furnace. A trial of the Ruby with liquid fuel was made in September last, in Long Reach measured mile, with the following results:—

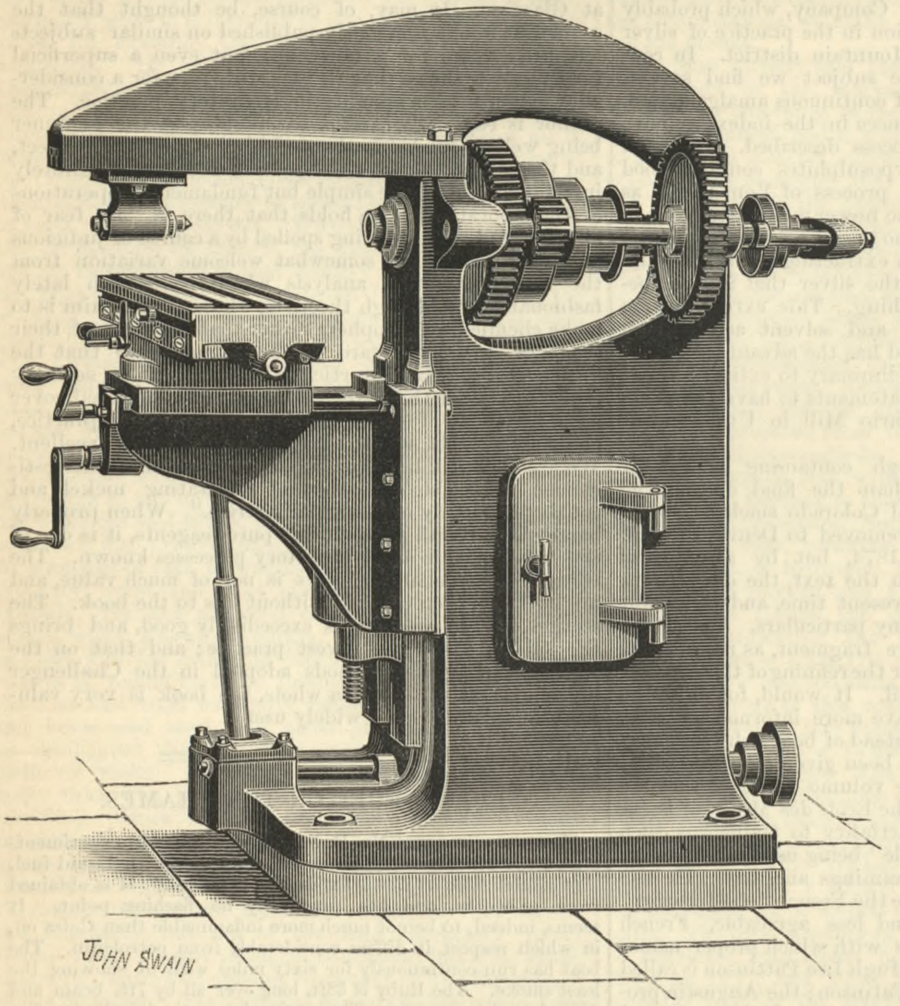
Mean speed with and against tide	8·1 knots
Mean revolutions per minute	288
Mean working pressure	102 lb.
Mean indicated horse-power	23
Mean consumption of liquid fuel per hour	55 lb.
Quantity of fuel carried (twenty-four hours' supply)	1344 lb.

The indicated horse-power on each occasion taken by Messrs. J. J. Thorneycroft and Co. The present price of green oil is very fanciful; last year it was under 19s. per ton, now it is 28s. 6d. The liquid fuel is carried in tanks at the sides of the boiler and one on top, from which a pipe is led to the injector, which also receives a supply of steam from the dome, and by the simple arrangement of adjusting the supply of steam and oil the most intense and equable heat is obtained and most steadily maintained. We made an hour's trip in the Ruby last week, and found that an ample amount of steam was easily maintained, and at 75 lb. pressure the run from Westminster Bridge to Vauxhall Bridge was made in nine minutes against and six minutes with tide; the distance is one mile. There was not the least trace of smoke from the funnel. The feed-water was on all the time.

Adelaide Jubilee Exhibition.—We have pleasure in announcing that Messrs. Robey and Co., Globe Works, Lincoln, have been awarded six first prizes at the Adelaide Exhibition for their horizontal automatic engine, compound portable engine, portable winding engine, wrought angle-iron framed thrashing machine, patent Robey winding engine, with wrought iron tank foundations, and centrifugal pumps. Messrs. Richard Garrett and Sons, Leiston, Suffolk, have been awarded "the first order of merit" for their corrugated fire-box, compound portable engine, single-cylinder portable engine, compound semi-portable winding engine, and mining engine with vertical boiler.

UNIVERSAL MILLING MACHINE.

MESSRS. TANGYE AND CO., ENGINEERS, BIRMINGHAM.



UNIVERSAL MILLING MACHINE.

THE accompanying engraving illustrates a Universal Milling Machine by Messrs. Tangye, Birmingham, with a self-acting table, having 23in. longitudinal travel, and lowering 13·72in. below centres. The headstock is double-geared, and has conical bearings and a removable top to allow of using large cutter heads in face milling. The table has a stop motion, and is driven from a vertical shaft at the centre, which allows it to be swivelled to 45 deg. without necessitating the usual alteration of shafts. The bracket slides are square, to enable heavy cuts to be taken without jarring. The weight of the machine, with the countershaft, is 1270 lb.

SEAMLESS TUBES FROM SOLID BLANKS.

THERE has been considerable interest lately in the recent German processes for making seamless tubes from solid blanks, and we give herewith cuts showing some of the methods. It will be seen that the rolls are placed so that their axes lie in vertical planes parallel with each other, and in oblique planes not parallel, and inclined to the horizontal at certain varying angles. The faces of the rolls are conical and grooved or ridged spirally. The inclination of the axes and the coning of the rolls, it is said, depend upon the effect which is sought, and vary with different materials. The grooving of the faces of the rolls is not essential. Ordinarily three or four rolls are employed to preserve the direction of the blank as it travels through; but this is done by guides when two rolls only are employed. As the blank passes through the rolls the surface is carried forward more rapidly than the interior of the ingot, and the result is that it finally leaves the rolls, where the space between them is least, in the form of a seamless tube, with a smooth interior surface. In Fig. 1, which is a plan, the blank B is shown as just engaged by the rolls A a, and the flange shown at the forward

FIG. 1

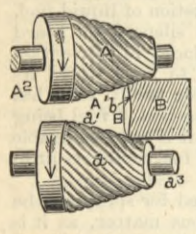
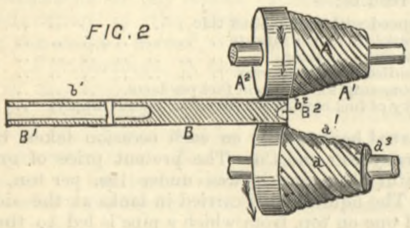
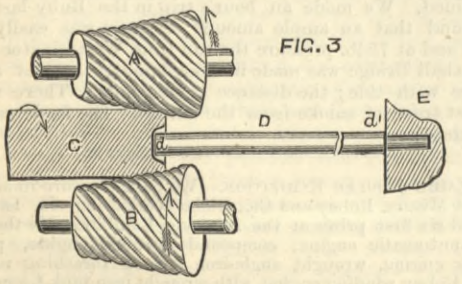


FIG. 2



end of the blank is the beginning of the tube. In Fig. 2 is shown the tube as finished. It will be seen that the end of the tube is

FIG. 3



closed, so that the process is well adapted for the formation of tubes having one end solid.

In Figs. 3 and 4 is shown a modification in which the tube is formed over a punch, which prevents the end of the tube being closed at the conclusion of the process. This form is used in making tubes from iron or steel, in which metals the blank is highly heated before being put into the rolls. The small conical fragment marked C^2, Fig. 4, at the end of the punch d^2, is all that remains of the ingot when the tube is finished. The employment of this punch renders it unnecessary to reduce the diameter of the blank so much as when the rolls are used without the punch. When the blanks are metals which are comparatively soft and ductile, and do not need to be heated to a high temperature before rolling, a mandril with a conical point is used, as shown at B, Fig. 5. By this process a tube is made, the inner diameter of which is determined by the base of the cone B. It is suggested that this mandril may be made hollow and kept cool by the circulation of a fluid through its interior.

In Figs. 6 and 7 is shown still another modification of the process, in which the mandril C aids in carrying forward the metal of which the tube is formed. It will be seen that the mandril has a conical head with spiral grooves. The blank B is fed into the rolls through a guide tube B^1. The speed with which the blank is fed forward may be somewhat moderated by causing the mandril C to rotate in the same direction as that in which the blank itself is revolving, or it may be accelerated by causing the mandril to revolve in the opposite direction. It is said that tubes made by this process have a comparatively smooth internal surface, and the fibres are continuous and lie spirally around the axis of the tube. For making tubes of copper or other soft metals of a diameter larger than that of

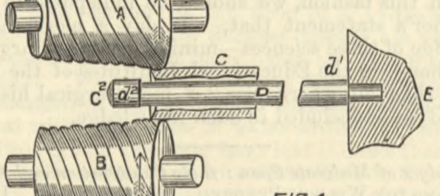


FIG. 4

the blank, the method shown in Fig. 10 is used. Here the rolls are not cones, but somewhat barrel-shaped. In this case it will be seen that the blank engages at the larger end of the rolls, and is forced forward over the conical mandril.

Another process is based upon the discovery that by suitably adjusting the angles of the axes and faces of the rolls, and their

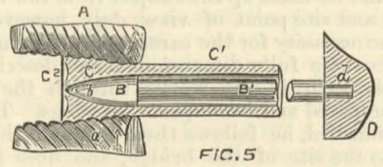
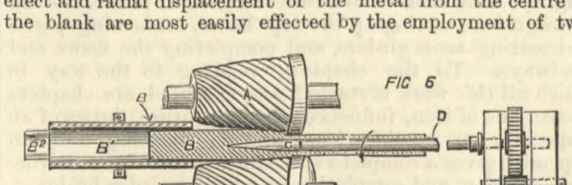


FIG. 5

lengths, they will operate to develope a tubular formation in any part of a solid metal ingot or blank which is submitted to their action, by causing a rupture of the metal along the line of the geometric axis, as shown in Fig. 8. The desired rupturing effect and radial displacement of the metal from the centre of the blank are most easily effected by the employment of two

FIG. 6



rolls, which act on opposite sides of the blank. The forces to which the blank is subjected in its passage between the rolls are of complex character. The two rolls act upon the opposite sides of the blank with a kneading effect, compressing the metal against which they impinge to a certain depth beneath the surface. The area of the metal thus compressed is indicated

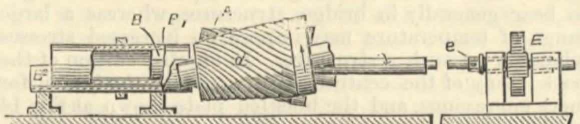


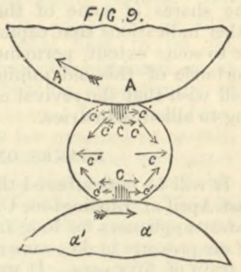
FIG. 7

approximately by the lined triangles C C, shown in Fig. 9. The direction in which the forces of compression are propagated from the places where the rolls impinge upon the blank is indicated by the diverging arrows. It will be seen that the resultant effect of these forces is to impart to the part of the blank under compression a tendency to expand laterally. The final effect of the action of the rolls is to compact the surface and cause a rupture along the axis of the blank, and this action aids the longitudinal action in producing a tube with comparatively smooth interior surface.

Tubes made by this process are said to be well finished both inside and out, and some specimens shown in this country seem to sustain the statement. We have no particulars as to cost of manufacture, probable selling price, and range of sizes which can be manufactured. The process is apparently a cheap one, and seems suitable for producing tubes up to 4in. or 5in. in diameter at least. Such tubes are pretty sure to supersede the ordinary lap-welded boiler tubes in use at present, if there

FIG. 8

FIG. 9.



is no marked difference in price. Iron pipes and tubes, as is well known, have a fibrous structure, the fibres lying longitudinally, so that the resistance to rupture is across the fibres, or in the weakest direction of the material; and, moreover, the strength of such tubes is measured by the resistance of the weakest part, which is generally the weld. Steel, on the contrary, has a crystalline structure, and offers equal resistance in all directions; and not being weakened by a weld, the strength of the steel tube is measured by the tensile strength of the material composing it.

A process has been patented in this country, but not yet introduced, for rolling seamless steel tubes of any size from hollow ingots while in a heated state. For tubes and pipes of moderate

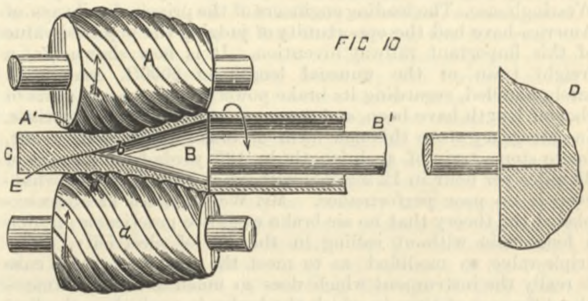


FIG. 10

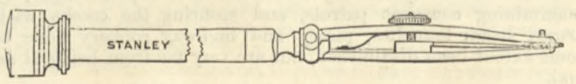
dimensions the hollow ingot is cast with an internal diameter equal to the finished size, and this ingot is drawn, over a mandril, through adjustable rolls which, in successive passes, reduce the ingot to a pipe or tube of the required thickness. For very large cylinders, such as water mains and boiler shells, the hollow ingot is cast with the required outside diameter, and is drawn through rolls over an expanding mandril, the internal diameter being increased at each pass until a cylinder or pipe of the desired thickness is produced.

It will be evident that, since seamless steel tubes have much greater strength than welded or rivetted iron tubes of the same thickness, the former can be much thinner, and consequently lighter, for given pressures, than the iron tubes, or will be suitable for much higher pressures if made of the same thickness. Indeed, if well-finished seamless steel tubes can be produced at moderate cost and of suitable sizes, no arguments will be required to introduce them; and we shall look with interest to all movements made for putting them upon the market.

We have reproduced from the *American Machinist* the illustrations of this process.

STANLEY'S WHEEL PEN.

THE accompanying engraving illustrates a new wheel pen made by Mr. W. F. Stanley, on the principle of his bordering pen with an inner nib, which nib in this case just reaches the



rowel. It is found by experiment to require very little care, and that it will make with one supply of ink 60ft. of continuous dots, whereas other pens usually fail in a few feet. It is easily cleaned and kept in order.

TENDERS.

BOROUGH OF LEICESTER.

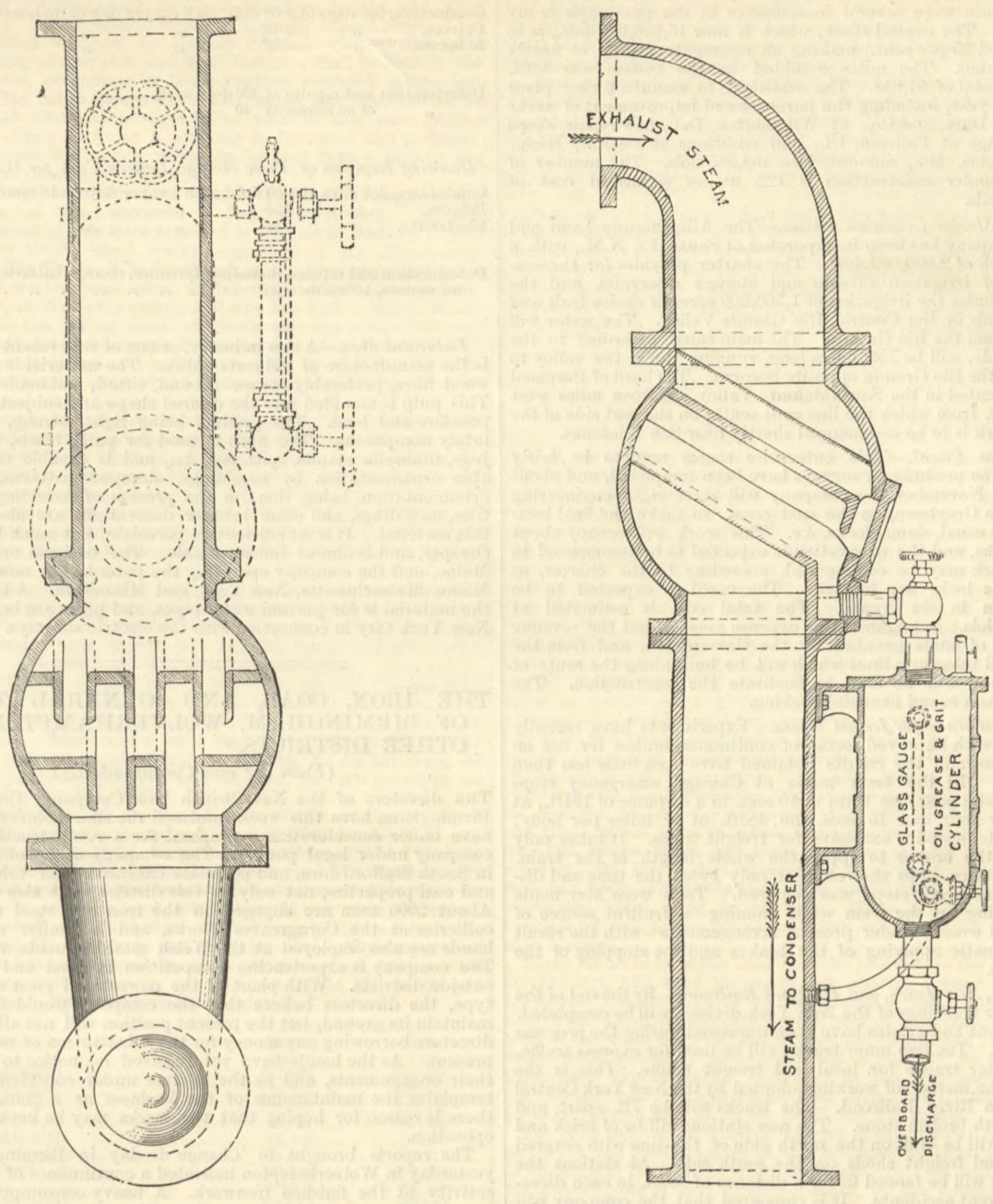
LIST of tenders for the construction of about 470 yards of pipe sewers, with manholes, lampholes, and other works in connection therewith, in the borough of Leicester. Plans, specification, and quantities by Mr. J. Gordon, M. Inst. C.E., borough surveyor:—

	£ s. d.		£ s. d.
Thos. Smart, Nottingham	744 8 0	..	Alternative
Jas. Dickson, St. Alban's	459 17 1	..	457 9 7
Innes and Wood, Birmingham	425 1 9	..	414 7 0
S. and E. Bentley, Leicester (accepted)	366 2 2	..	350 19 2

A TECHNICAL school of clock and watch making, due to the initiative of the King of the Belgians, has been opened at the *Ecole Industrielle*, in the Palais du Midi, Brussels, with the object of introducing this branch of industry into Belgium.

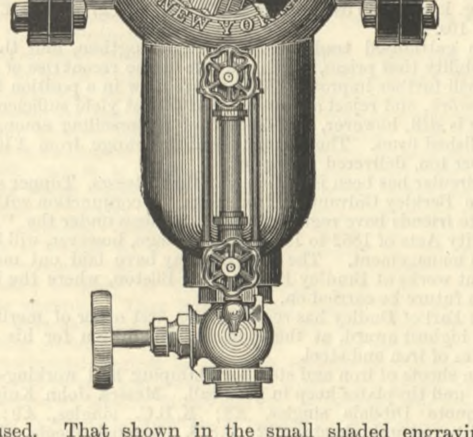
NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Frank W. Hawkins, engineer, to the Indus, additional, to date November 4th; William Bromley (a), engineer, to the Reindeer, and Thomas Williams, engineer, to the Kingfisher, both additional, and for appointment when recommissioned, to date November 7th; Percy D. Martell and Henry J. Allen, assistant engineers, to the Monarch, lent for training; William C. Stevens and Joseph H. H. Ireland, assistant engineers, to the Sultan, lent for training; James A. Royce and James M. Simpson, assistant engineers, to the Agincourt, lent for training; Charles Banister, assistant engineer, to the Iron Duke, lent for training; William S. Frowd, assistant engineer, to the Iron Duke; William C. Morcom, assistant engineer, to the Agincourt; and Cuthbert R. Roger, assistant engineer, to the Sultan—all the above to date November 7th; Donald P. Green, acting assistant engineer, to the Agamemnon, additional, and for appointment, as additional, when recommissioned, to date November 14th.

STUART'S STEAM GREASE EXTRACTOR.



STUART'S STEAM GREASE EXTRACTOR.

The accompanying engravings illustrate an apparatus now being introduced by Messrs. Purdey, of Liverpool, into this country from the United States, for extracting grease and dirt from steam. The apparatus is in use in several ships, and giving, we understand, complete satisfaction. Its action will be readily understood from the engravings. The steam impinging on the inclined plates leaves the grease adhering to them. All the grease and dirt are thus taken out of the exhaust steam, and so the condenser tubes are kept clean, while the oil can in some cases be, and actually is, used over again. There are several



forms used. That shown in the small shaded engraving is intended for use in stationary land engines. The sectional engravings show the normal or "No. 2" type used at sea.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

Brazil, Finances of.—The Brazilian Government is entirely dependent on Customs duties for 70 per cent of its revenue. From a fiscal point of view therefore the development and extension of foreign trade is important to this country. Up to a recent date the Customs duties on nearly all articles were very high, and by the new tariff of 1st July last they were considerably increased. Importers and merchants here have brought in large quantities of goods at the old rate of duties, which they will be able to sell at prices corresponding to the present tariff. This must necessarily cause a decrease of imports in the next few months. The coffee crop—the chief product of Brazil—it is said will be very small. The prospects of the coffee planters are not encouraging, the impending abolition of slavery, and the consequent difficulty of procuring labour in lieu thereof, render it probable that there will be a permanent falling off in the quantity of coffee exported, and consequently in the purchasing power of the country as regards imported goods. The Minister of Finance, in preparing his budget for 1888, has not taken these facts into consideration, and it is likely that the deficit for the year 1888 will greatly exceed the amount of £611,200 estimated. Taking this in connection with the enormous increase—£13,000,000—in the public debt during last year, the finances of the empire do not appear to be in a satisfactory condition.

The United States Consul-General at Rio de Janiero reports on the same subject, similarly: The finances of Brazil have been for a long time in an unsatisfactory state, and the present Government is endeavouring to improve them. It has before it a very difficult task. Many causes contribute to the unsatisfactory state of Brazilian finances, but the most important among them is the labour question. The peculiar misfortune of Brazil at the present time is destroying the existing system of labour without being able entirely to replace it. Better means of communication, free labour, immigration, and other favourable circumstances have exercised a beneficial influence on the financial affairs of the country; but the normal rate of progress has not been kept up, and while public expenses have grown, production has not increased in the same proportion. The commercial development of the empire, which at one time progressed favourably, is at present slow, in some places stationary, and in others declining. It was hoped that the construction of central sugar mills, railroads, and generous aid to navigation, would give trade a vigorous stimulus. In the last twenty years many costly central sugar mills have been erected, about 4000 miles of railways constructed, and the State expends annually in subsidies to navigation nearly £309,000. The country has done as much as was in its power to aid these improvements, and they have had much influence on trade. The freight rates are much too high, neither the railways nor the sugar mills, with few exceptions, pay reasonable interest on the invested capital, and some of them do not even pay working expenses; but they have in many ways contributed towards stimulating commercial transactions. On the other hand, they have helped to save public expenses without neutralising the evils caused by the undue increase of those expenses. Brazil possesses vast natural resources. It is to be hoped that the development of these will help the empire in passing safely through the perils surrounding it.

China—Trade of Canton in 1886.—The returns in this report are the returns of that portion only passing through the foreign Customs. Of the total of 2,586,689 tons, the British flag covered 2,176,740, or 84 per cent., the nearest to which was the Chinese—294,948, or 11½ per cent. Flag is not necessarily identical with interest, and if the whole of the British vessels were placed under the Chinese or other flag our interest in them would probably remain the same. With the termination of the Tongking troubles there has been a considerable revival of native trade, and there is outwardly every sign of prosperity, the effect of the war being to open out the country and strengthen the local Government; but much remains to be done before life and property are secure. In the numerous native shops every foreign article is to be found, but generally these are but cheap imitations, imported into Hong Kong by the ton, sold by auction, and sent up by the agents of the native shops, careless and ignorant in regard of guarantee of goodness and maker. They thus pass into the hands of country visitors, but until a better class of goods is supplied they cannot have a continuous and increasing demand. It is to the interest of foreign manufacturers for foreign tradesmen to settle here to supply both retail and wholesale purchasers. It might be a struggle at first, in the face of bitter opposition and keen competition, but a few good shops supplying good articles only would, after a time, do a good and profitable business. There is a growing taste for foreign articles, and tradesmen must look to the natives and not foreigners for their customers, as some of them have experienced. In this course there will be serious risks. For details see report, paragraph 9, page 2, and paragraph 3, page 3. There will be shortly considerable openings for business in the requirements of the iron road. Before long railways and telegraphs will be commenced and rapidly spread through the empire, the materials for which must come from abroad. It is to be hoped that the Government will adhere to their determination to grant no concession to foreigners; there is more money to be made in supplying their wants and doing their work, than in finding the capital and taking the risk in the hope of future profits. Knowing so little as we do of the country, investment in Chinese railway stock must nearly always be a wild speculation, from which only the manipulators of the shares can hope to get any return. A further increase in the tonnage is threatened next year, in the establishment of a new line of passenger steamers between here and Hong Kong. The success of the line is doubtful, through the very great initial expense of the high speed at which the steamers are to be run, which will not afford the great inducement to passengers anticipated. The present steamers run much under their possible speed, and making fast passages does not attract more passengers. There would be a more profitable field if the West River were opened, as promised, and there is a probability that steam power will shortly be introduced in the internal navigation. As the introduction of steamers on the coast has ruined the pirates' business, so will their introduction into the interior put a stop to river robbery, and the public voice is daily more loudly demanding this concession. As previously, the lekin question has been the prominent subject here. Lekin is a tax levied upon goods after they have left the hands of the foreign importer, and is the great burden under which the empire suffers, and all developement of trade is rendered impossible by its crushing weight. The Chinese view that the moment goods are sold to Chinese the Government have a right to tax their own subjects' property as they please, has been admitted by the Chefoo Convention, the area in which goods are exempt from lekin being defined to be the limits of the foreign concessions—*i.e.*, in Canton, the warehouses of the foreign residents. To make their goods marketable, the foreign importers are compelled to pay lekin as well as import duties. Apart from the injury done to the manufacturers at home by the increased taxation on their goods, the business of the foreign resident importer is destroyed. When the collection is not farmed to some local syndicate, who thus obtains a monopoly of the trade it is collected in the usual Asiatic manner, and the foreigner thereby put out of competition. A foreigner has to pay full lekin on his goods, but his native rival makes an arrangement with the lekin receivers to pay a portion only, the difference being shared between them. The import business of the resident foreigners, therefore, last year fell off, and in some parts is at an end. As a remedy for this state of things, it has been proposed to entrust the collection of lekin to the foreign Customs, but this alone would be prejudicial rather than the reverse.

Japan.—Commercial museum at Tokio.—The Japanese Government have attached to the School of Commerce, Tokio, a commercial museum for exhibiting to Japanese importers foreign articles likely to be of interest. European merchants desirous of contributing to the museum should forward specimens addressed to Mr. Takashi Masuda, Hitotsubashidari, Tokio, Japan.

Mexico—Minerals and mines of Vera Cruz.—The State of Vera Cruz is exceedingly rich in minerals and mines, but they have never been properly worked, chiefly owing to the want of political tranquillity and the consequent diversion of mining capital and enterprise to the Northern States. Vera Cruz contains eighteen cantons, in twelve of which mines have already been discovered, which may be divided into three groups of four each, the Eastern, Southern, and Western. The Eastern group borders on the gulf for about 160 miles, the Western forming a parallel line of about the same length. The Southern group lies to the south of the preceding, and is of much less importance. The number of mines discovered is 335, of which nine are asphalte, eighty-two coal, and 126 petroleum. The petroleum springs are found in a line 150 miles long, about from 5 to 15 miles from the coast, running through the Eastern cantons at a level of from a few hundred to about 2500ft. above the sea. The coal deposits are in a parallel line of equal length, running through the Western cantons 15 to 40 miles from the coast, at a height of from 2000ft. to 4000ft. above the level of the sea. The principal deposits of asphalte are between the lines of coal and petroleum. Other mines of asphalte, coal, and petroleum may exist South-west of the two main lines, as only a general idea of the extent of the Vera Cruz minerals and mines can be formed until systematic borings shall have been made by experts, which will have to be done by foreign capital and enterprise, the natives having hardly any of either. The coal is near the surface, and even the lower seams could most probably be easily worked, as the sloping ground is favourable for dealing with any water that might be met with. The seams may be a good deal out of the horizontal and contain many faults, as they have doubtless been elevated to their present height by volcanic action. The coal could probably be got for 5s. 4d. per ton and conveyed to the coast at 2d. per ton per mile; taking the distance at 50 miles, the cost price of coal at the coast would be 13s. 4d. per ton. The market price at Vera Cruz being about £2 per ton, there would be a large margin for contingencies and profit. The petroleum is near the coast, and might be brought to it in pipes, and the petroleum industry is protected by high import duties, viz.:—1s. 8½d. per cwt. on crude petroleum, and 17s. per cwt. on refined, equal to 35 and 300 per cent. *ad valorem.* There is a petroleum refinery near Vera Cruz importing its crude oil from the United States, and generally believed to be making enormous profits. Native oil protected by import duties will doubtless compete successfully with this. As the mines under consideration would be valueless unless economically worked, and their produce cheaply transported to market, the climate, communication, and cost of labour must be considered. The petroleum district being comparatively low, is not very healthy, though the native population do not suffer much from it. The coal district being much higher is cooler and healthier. The communications are not very good, though the proximity of the mining districts to the coast, and their sloping towards it, render them cheaper and easier than those of other States. In the eastern countries of Ozuluama and Tuxpan there is a laguna of from two to fifteen miles broad running between the coast and the petroleum line for about sixty-five miles, which is navigable for flat-bottomed boats. Parallel with the laguna, along the petroleum line, is a road from the north of Ozuluama to the port of Tuxpan. The communications with the coal line behind the petroleum are longer and more difficult. The roads are inadequate, and to develope the coalfields requires a series of tramways of 30in. gauge laid with steel rails of about 20 lb.

to the yard, and costing about £400 per mile without bridges and earthworks, which usually would be inexpensive. The gradients might be what is called severe, without materially increasing working expenses. The length of these tramways would vary from thirty to fifty miles, curves often being required to avoid steep gradients. Most of them would be more economically worked by steam power, but some by mules, which are cheap both to buy and keep. The tramways would be available for general traffic, which would be considerable and continually increasing, the land being most fertile and only requiring communication to develope it. Labour is cheap, the average wages being 1s. 1d. per day; but extensive mining would, doubtless, raise the rate. It seems that working these coal and petroleum fields would pay, and an attempt to work the latter is being made by an American company, who are sinking three wells thirty-five miles west of Tuxpan. One of the wells is 300ft. deep, and the crude oil has been satisfactorily tested at New Orleans. The company intend to refine the oil themselves, and are transporting the necessary machinery to the wells. The enterprise will probably fail through the company relying on the country roads for its communications, and the consequent swallowing up of profits in expenses of transport. To work the mines in this State with success a tramway is an absolute necessity. It is highly probable that systematic boring may discover other important mines in the State, particularly in the canton of Julucingo, about seventy-five miles north-west of Vera Cruz, situate in a most agreeable and healthy climate forty-five miles from the coast, communication with which might easily be effected by a narrow gauge tramway following the mountain streams, with an average gradient not over 1 in 50. All mines are public property, and are granted on condition of being worked and paying a very moderate royalty. No part of the minerals of Vera Cruz can be economically worked without great expenditure of capital in providing communications. Taking Jalacingo as a typical case, the least amount required for developing its mines should be £100,000, which, properly expended, after adequate borings and surveys, would yield a large dividend on even a moderately successful mining venture. The Governments, both of the Republic and State, are anxious to foster and protect all enterprises tending to develope the country, and grant them, amongst other privileges, freedom from taxation and the right to take public lands for tramways.

Mexico—Cotton factories at Vera Cruz.—There are eight cotton mills, employing over 2000 hands at an average rate of 1s. 7d. per day, as against 1s. 1½d. for agricultural labourers. The motive power used in these factories is almost exclusively water, which exists in the State to an enormous extent, the land sloping from west to east 5000ft. in eighty-four miles; but this immense water power is only used by the cotton factories to the extent of 815-horse power. Flour mills may perhaps appropriate the water power to double that extent. With such cheap power and an unprecedented degree of protection, Mexican factories can restrict the importation of British cotton cloth, though they cannot exclude it, for in 1886 Vera Cruz imported British cotton cloth to the value of £225,000, or 56 per cent. over the produce of the foregoing native factories. This year the British import is expected to be larger, owing to the reduced duties which came into operation on the 1st of August last.

Russia—Exhibition at Warsaw.—An exhibition of textile goods and machinery, under the patronage of the Warsaw branch of the Russian Society for the Encouragement of Industry and Trade, open to all countries, will be held in that city about the middle of December next. Among the articles especially suited to this market are beltings, dyes, and all kinds of textile machinery. The goods to be exhibited are divided into twelve classes: Belting being No. 9; chemicals and dyes, No. 10; textile machinery, confined to machinery and models requiring but little space, descriptions, plans and sketches, (advertisements of machinery manufacturers are solicited for insertion in the catalogue), No. 11; publications in connection with textile industries, No. 12. The committee are Count Louis Krasinski, president; Mieczyslono Epstein, vice-president; Count Zygmund Rzyszczewski, and Stanislaw Wolowski. The forwarding agent is Maurice Luxemberg, and the offices are at Faubourg de Cracovie, Warsaw.

St. Thomas—Trade in 1886.—Imports into St. Thomas declined 30 per cent. under those of the previous year. Though British imports shared in the general decline, they still form the largest portion—32⅔ per cent.—and have decreased in a less ratio than those of other countries. The decline in the trade of the island will probably continue until every adjacent island possessing a town is supplied directly from the producing centres. The extension of marine telegraphs and the development of steam navigation have enabled charterers and shipowners to communicate directly with each other. Consequently, St. Thomas is rapidly losing its importance as a port of call, and the chartering business is yearly decreasing. The Royal Mail Steamship Company, who had headquarters here for many years, removed to Barbadoes in 1883, and the Compagnie Générale Transatlantique partially abandoned the island for Martinique in 1885. The loss caused to St. Thomas by the departure of these two companies is not less than £50,000 per annum. The Danish authorities have made efforts to arrest this abandonment of the port by materially lowering the dues on shipping; but too late, and probably the loss of shipping business will be added to that of trade in merchandise. From the foregoing causes the island has suffered severely. Year by year houses close their business, but few remain, and they have to combine the wholesale with the retail and take up any kind of business that offers. Money making is quite out of the question; many find it difficult to make expenditure and income meet. A hope exists that St. Thomas will regain some of its prosperity when the Panama Canal is opened to navigation. It is thought that the island will be made a great coaling station, and a port of call for all vessels coming from or going to the canal. Why this should be remains to be explained, as it is natural to suppose that Colon and Panama will be the coaling and provisioning points.

Turkey—Trade of Kharput in 1886.—The trade of this vilayet during the past year has been fairly prosperous, there having been an increase in every branch of trade amounting to 10 per cent. over the total of the previous year. A German merchant has just passed through Kharput on his way to Mosoul. He intends to establish commercial houses at Diarbekir and Mosoul. A third German house will probably be established at Kharput. This is an important movement, from a commercial point of view, and may in time affect British trade in this country. A commercial museum is about to be opened at Trebizond under the auspices of the Belgian Consulate.

The total cost of the harbour defences of New Zealand up to the end of the financial year was £155,243, which includes the amounts paid for land, buildings, &c., but not for guns, ammunition, and torpedo boats, the cost of which amounts to £153,583. Up to the present the total expenditure has been £393,605.

AMERICAN ENGINEERING NEWS.

(*From a Correspondent.*)

The Pullman Palace Car Company.—Owing to errors in the first reports, there were several inaccuracies in the paragraph in my last letter. The capital stock, which is now 15,920,000 dols., is to be increased 25 per cent., making an aggregate capital of nearly 20,000,000 dols. The mileage added to the system was 8804, making a total of 81,348. The additions to manufacturing plant during the year, including the purchase and improvement of works of Bowers, Dure, and Co., at Wilmington, Del., new repair shops and buildings at Pullman, Ill., and additions at Detroit, Mich., and St. Louis, Mo., amounted to 459,265 dols. The number of cars now under construction is 122, at an estimated cost of 1,760,000 dols.

A New Mexico irrigation scheme.—The Albuquerque Land and Water Company has been incorporated at Santa Fé, N.M., with a capital stock of 2,000,000 dols. The charter provides for the construction of irrigation ditches and storage reservoirs, and the scheme includes the irrigation of 1,500,000 acres of choice fruit and farming lands in the Central Rio Grande Valley. The water will be taken from the Rio Grande. The main canal, according to the surveys made, will be 150 miles long, running down the valley to a point on the Rio Grande opposite Socorro. The head of the canal has been located in the San Ildefonzo Valley, eighteen miles west of Santa Fé, from which the line runs south, on the east side of the river. Work is to be commenced shortly near San Ildefonzo.

Nicaragua Canal.—This enterprise seems now to be fairly started. The preliminary surveys have been completed, and about the end of November the company will start eight engineering parties from Greytown, on the east coast, to make the final location for the canal, dams, locks, &c. This work will occupy about eight months, and the excavation is expected to be commenced in July, as work may be commenced, according to the charter, as soon as the locks are located. The canal is expected to be in operation in six years. The total cost is estimated at 65,000,000 dols.; but against this expense must be put the revenue for the sale of lands granted by the Government, and from the railroad and telegraph lines which will be built along the route of the canal, and will be used to facilitate the construction. The company has a sound financial backing.

Continuous brakes for freight trains.—Experiments have recently been made with improved forms of continuous brakes for use on freight trains, and the results obtained have been little less than marvellous. In the tests made at Chicago, emergency stops resulted in stopping the train in 10 secs. in a distance of 184ft., at 22 miles per hour, and 15 secs. and 488ft. at 37 miles per hour; but this latter speed is excessive for freight trains. It takes only 2 secs. for the brakes to apply the whole length of the train. Ordinary service stops showed that only twice the time and distance of emergency stops was required. Tests were also made with breaking up the train while running—a fruitful source of damage and wrecks under present arrangements—with the result of the automatic applying of the brakes and the stopping of the two sections.

New York, New Haven, and Hartford Railroad.—By the end of the year the four trackings of the New York division will be completed. The alignment and grades have been improved during the progress of the work. The two inner tracks will be used for express traffic, and the outer tracks for local and freight traffic. This is the reverse of the method of working adopted by the New York Central and Hudson River Railroad. The tracks will be 7ft. apart, and ballasted with broken stone. The new stations will be of brick and stone, and will be built on the north side of the line with covered platforms and freight sheds on the south side. At stations the inner tracks will be fenced in for a distance of 500ft. in each direction, to prevent accidents. It is rumoured that the company will acquire the Boston and Providence Railroad, and own a through line from New York to Providence, over what is known as the "Shore Line." At present the through trains on the "Shore Line" run from Boston, Mass., to Providence, R.I., on the Boston and Providence Railroad, from there to New London, Conn., on the New York, Providence, and Boston Railroad, and from New London to New York, on the New York, New Haven and Hartford Railroad, each road hauling the train with its own engines. At New London, Conn., the trains are ferried over the Thames river on large double-track transfer steamers, but the New York, New Haven, and Hartford Railroad Company has a charter for a bridge across the river. Grade crossings are being abolished on this road, and all the several improvements will result in a considerable shortening of the time between New York and Boston. The schedule time is six hours (230 miles), but the New York, New Haven, and Hartford Railroad has an unenviable reputation for being behind-hand.

Railroad notes.—The Denver and Rio Grande Railroad is locating a line from Dallas, Col., to Rico, *viâ* Telluride, Ames, and Ophir. The engineer's report is favourable, the route being pronounced as easy and with moderate grades. The line is to benefit the mining region which will be traversed, and as about thirty mining properties will be accommodated, the line will produce a heavy freight traffic. The Deming, Sierra Madre, and Pacific Railroad Company has been incorporated at Santa Fé, N.M., to build a line from Deming south to the Mexican boundary, where it will connect with a projected Mexican line, which will run to Sinaloa and the Pacific coast. The construction material is to be purchased in England. The Duluth, South Shore, and Atlantic Railroad will probably not be able to make its Northern Pacific connections and reach Duluth, Minn., until next July, owing to delay in obtaining the rails. The road bed is completed and ready for track laying. Negotiations are pending for the use of forty-five miles of the Northern Pacific Railroad, but if they are not successful the road will build an independent line into Duluth. The road will have a large ore traffic for the Gogebic range, and the upper peninsula of Michigan. Sixteen large Mogul engines are ordered to be delivered next spring. The St. Paul and Duluth Railroad will build an air line extension from St. Paul, Minn., to Omaha, Neb. The surveys are made, but grading will probably not be started till next spring. Both Mankato, Minn.—thirteen miles off the route—and Sioux City, Ia.—have offered inducements for the line to touch these cities—Sioux City offered 300,000 dols.—but the company persists in its air-line scheme, saying, however, that when the main line is built feeders will be extended. As a rule it is not wise to sacrifice good places on a route for the advantages of an air line. The Oregon Pacific Railroad is under construction from Albany, Ore., eastward; its ultimate terminus is Boise City, Idaho. The Vancouver, Klikitat, and Yakima Railroad and the North Yakima, Columbia River, and Spokane Railroad, newly-projected lines, will together form a line from Vancouver, in Washington territory, to British Columbia; crossing the Columbia River at Priest Rapids, near Yakima, and connecting with the Canadian Pacific Railroad. The line will open up valuable beds of lignite coal, mineral regions, forests, and grain fields. The Denver and Rio Grande Railroad is contemplating a line south to Santa Fé, N.M.

Street Railroad Convention.—The sixth annual meeting of the American Street Railway Association was held at Philadelphia, Pa., on October 19th, 20th, 21st. The Convention was well attended, and its proceedings proved of great interest, the matter of electricity occupying the greater part of the time devoted to discussion. Mr. Wharton read an able paper on "Electricity as a Motive-power," Mr. C. A. Richards read one on "Street Railroad Construction"—in which he recommended stronger track and larger cars—and Mr. E. E. Ries read another on "A New Method of Increasing the Tractive Adhesion of Driving Wheels." Mr. F. J. Sprague delivered an address on "The Application of Electricity to Street Railroads," and Mr. C. J. Van Depoele on "The Electric Railroads in America." Mr. R. W. Blackwell spoke in opposition to the storage battery system and in favour of the Bentley-Knight conduit system. The following estimate of operating expenses, submitted by Mr. Wharton, is interesting:—

Running Expenses of Four 2-Horse Cars for One Year.—

	Dols
Conductors, 365 days at 3·00 dols. each car per day of 16 hours ..	4380
Drivers, ,, 2·50 ,, ,, ..	3650
36 horses, ,, ·50 ,, ,, ..	6570
	14,600
Deterioration and repairs at 200 dols. each	800
,, of 36 horses at 40 ,, ...	1440
	16,840

Running Expenses of Three Storage Battery Cars for One Year.—

Conductors, 365 days at 3·00 dols. each car per day of 16 hours	3285·00
Drivers, ,, 2·50 ,, ,,	2737·50
Electricity, ,, 2·00 ,, ,,	2190·00
	8212·50
Deterioration and repairs, including dynamos, storage batteries and motors, 1600 dols. each	4800·00
	13,012·50

Indurated fibre.—A new industry, or one of very recent beginning, is the manufacture of indurated fibre. The material is made from wood fibre, preferably spruce ground, sifted, and made into pulp. This pulp is moulded into the desired shape and subjected to high pressure and heat. The product being light, strong, and absolutely non-porous. The fibre is used for pails, bowls, bath tubs, jugs, umbrella stands, spittoons, &c., and is capable of considerable ornamentation by mouldings, stamped patterns, &c., the ornamentation being done in the process of moulding. Ceiling tiles, mouldings, and other interior decorations are also made of this material. It is as efficient as porcelain, but much lighter and cheaper, and is almost indestructible. The business originated in Maine, and the company operating the patents has now works in Maine, Massachusetts, New York, and Minnesota. A later use of the material is for gas and water pipes, and pipes are being laid in New York City in connection with the electric subways.

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

(*From our own Correspondent.*)

The directors of the New British Iron Company, Corngreaves, Birmingham, have this week informed the shareholders that they have under consideration a proposal for a reconstruction of the company under legal powers. The company is one of the oldest in South Staffordshire, and possesses extensive and valuable iron and coal properties, not only in this district, but also in Wales. About 2000 men are engaged in the iron and steel works and collieries at the Corngreaves Works, and a similar number of hands are also employed at the Welsh establishments at Ruabon. The company is experiencing competition in steel and iron from outside districts. With plant of the newest and most economical type, the directors believe that the company would be able to maintain its ground, but the present position will not allow of the directors borrowing any money for the substitution of new for the present. As the hands have yet received no notice to terminate their engagements, and as the scheme under consideration contemplates the maintenance of the business as a going concern, there is reason for hoping that the works may be kept in active operation.

The reports brought to 'Change to-day in Birmingham and yesterday in Wolverhampton indicated a continuance of the recent activity at the finished ironwork. A heavy consumption of pig iron is going on, which is proof positive of a large outturn of manufactured iron. The best iron houses are, however, doing less than the second and third-class firms. The reduced prices of 20s. per ton on ordinary qualities and 30s. per ton on charcoal qualities recently announced by Jno. Bradley and Co. is attributed mainly to the example having been set by the Low Moor and Bowling Companies of South Yorkshire.

Prices of marked bars remain at £7, with £7 12s. 6d. as the Earl of Dudley's figure and £8 for Messrs. John Bradley and Co.'s bars. Second-class branded bars are £5 15s. to £6, while general merchant bars remain at £5 10s., and common £4 17s. 6d. to £5. The demand shows but little change upon recent reports, whether on home or export account. Tube strip and hoops are affording a fair extent of employment at the mills, but plates rule very dull and without any prospect of improvement. Strip remains at £5; hoops, £5 5s.; tank plates, £6 10s. to £7; boiler plates, £7 10s. to £8; and best, £9 to £10 per ton.

The sheet makers are still experiencing an excellent demand, at prices which show no abatement upon the recent advances. Prospects are, too, very good. The requirements of the galvanisers constitute the bulk of the work at the mills, and the sheets thus supplied are galvanised for export chiefly to South America, the Colonies, and the West Indies. Buyers maintain their interest in the suggested meeting between Belgian and English sheet makers, but no definite conference has yet been arranged. Sheets of 20 w.g. keep at £6 5s., 24 w.g. at £6 10s., and 27 w.g. at £7 7s. 6d. to £7 10s.

The galvanised trade continues to strengthen, and there is a probability that prices, which are firm at the recent rise of 10s. per ton, will further improve. Makers are now in a position to select their work, and reject any orders that do not yield sufficient profit. There is still, however, a good deal of underselling among newly established firms. The common qualities range from £10 10s. to £11 per ton, delivered Liverpool.

A circular has been issued stating that Messrs. Tupper and Co., of the Berkley Galvanised Ironworks, in conjunction with a few private friends have registered their business under the "Limited Liability Acts of 1862 to 1883." No change, however, will be made in the management. The new company have laid out more convenient works at Bradley Bridge, near Bilston, where the business will in future be carried on.

The Earl of Dudley has received the first order of merit, which is the highest award, at the Adelaide Exhibition for his case of samples of iron and steel.

Thin sheets of iron and steel for stamping and working-up purposes, and tin-plates keep in good call. Messrs. John Knight and Co. quote Dibdale singles, £8; K.B.C. singles, £9; crown, £10 10s.; plough sheets, £12; C.S.S. charcoal sheets, £14 10s.; and Knight's charcoal, £19 10s.; steel sheets are £10; Crown bars, £7; plough bars, £9; and charcoal bars, £15. Tin-plates the firm quotes:—Cookley K. charcoal, 23s. I.C.; C.S.S., charcoal, 21s.; and Woolverley, 19s. per box. Cokes they quote 19s. for I.C.; large tin sheets, of the Cookley K. charcoal brand, are 24s. 6d. per cwt. for singles; C.S.S. charcoal, 22s. 6d.; and Cookley coke, 21s. 6d. Doubles are 1s. 6d. per cwt. extra; and lattens, 3s. per cwt. extra.

Messrs. Hatton, Sons, and Co. quote thin iron sheets, for working-up purposes, of single gauge, at £10 to £12 per ton; charcoal, black sheets, £15 to £18 per ton; steel boiler plates, £7 to £8 per ton; soft steel sheets, heavy singles, £9 to £10 for deep stamping purposes and tinning; and doubles, 20s. to 30s. extra; with a yet further 20s. to 30s. per ton for lattens. Soft steel blooms and billets the firm quote about £5 15s. to £6.

Steel blooms, billets, bars, and plates are on order in large quantities, and offers are declined in some cases, since makers cannot guarantee delivery yet awhile. This remark applies alike to imported metal and to native manufacture. The great favour into which steel has of late got is proving a grand thing for the steelmasters, and the inquiry is so good that increased output is being aimed at in every direction.

The powerful new steel mill at the Brunswick Works of the

Patent Shaft and Axletree Company is answering every expectation, and is full of work upon large channel sections of steel, for the use mainly of the railway carriage and wagon builders, who are consigning increased quantities of the metal almost weekly in the construction of rolling-stock for South American, Indian, and other distant lines. Prices remain strong at recently-named rates.

The question will now be quickly decided whether the next spring meeting of the Iron and Steel Institute shall be held in the United States, according to the invitation received at the last meeting. The ballot papers have been issued, and they are to be filled up and returned at once. The vote in this part of the kingdom is likely to be in a majority in favour of the proposal. It is considered that much might be learned from a visit to the iron and steel centres of America.

The United States iron and steel masters still recognise the high value of the services of English engineers. If any additional proof of this were required to the recent drafting of two of the most skilful steel works' engineers of the Manchester district to the States, it is furnished in the circumstance that a young steel works' mechanical engineer, a native of this district, Mr. Walker, of Wolverhampton, and who has had a South Wales experience in the laying down of steelworks, has within the last few days left for Johnstown, Pennsylvania, to superintend the erection of a new steel rail mill there. Mr. Walter carries with him introductions to some of the leading iron and steelmasters of Pittsburgh.

The native pig iron makers report the acquisition of favourable orders, and deliveries they say are so heavy as to make an early increased production probable. The demand runs chiefly on medium qualities. Imported Midland pigs are also in very large delivery; but consumers are, as a rule, delaying new purchases until they can ascertain the course of the northern markets. Native all-mines are tame at 50s. for hot-blast sorts; part-mines are 35s. to 42s. 6d.; and common, 29s. to 30s. Imported pig prices are unaltered.

The condition of the iron and steel trades of South Staffordshire is favourably reflected in the Board of Trade returns for October. They show that the total quantity of iron and steel exported during that month was 342,994 tons, and the value £2,097,784, an increase of 7182 tons in quantity and £154,465 in value over October of last year. In the ten months the quantity was 3,453,785 tons and the value £20,677,629, an increase of 610,890 tons in quantity and £2,346,081 in value, as compared with last year. There was a very great drop last month in our exports of pig and puddled iron amounting to 35,484 tons, or 25·4 for the month in quantity and £41,619, or 16·6 in value, as compared with October, 1886.

With Russia alone the decline has been 30,000, or about 91 per cent, and with Germany it was just over £12,000, or about 41 per cent. There was a slight decrease, amounting only to £1148, in the month's exports of bar and angle iron. The figures with regard to cast and wrought iron show a decline of 3714 tons, or 8 per cent., in quantity, and £63,810, or 15 per cent., in value. Unwrought steel shows a decline of 7068 tons, or 24 per cent., in quantity, and £10,338, or 5 per cent., in value. The exports of railroad iron have developed to an enormous extent, the month's increase being 33,006 tons in quantity, and £144,127, or 63 per cent., in value. The following are the details:—

Iron.	Month of October. 1886. £	1887. £
Pig and puddled	247,575	205,956
Bar, angle, &c.	126,750	124,602
Railroad	229,369	373,496
Wire	45,051	57,230
Telegraphic ditto	60,467	31,475
Cast and wrought	419,921	356,111
Hoops, sheets, &c.	233,568	279,550
Old iron	30,062	71,241
Steel, unwrought	183,677	173,239
Hardware and cutlery	242,420	264,155
Machinery	655,489	792,497
Steam engines	234,282	205,204

Birmingham engineers are expecting to benefit from the inquiries which some of the leading Indian and home railway lines are now issuing for supplies of stores during next year.

The continued rise in the metal market is having an important effect upon the prices of certain of the Birmingham hardware branches in which copper figures as the raw material. The brass and copper wire drawers, sheet rollers, and tube drawers have advanced prices in successive amounts amounting in the aggregate to ¾d. per pound, and some firms have withdrawn all quotations. Other advances are certain to follow.

The strike of nailmakers in the Bromsgrove district has been brought to an end by the employers conceding the 1879 list, less 10 per cent. discount. This advance is justified by improved prospects of the trade resulting from lessened stocks and a stronger demand.

It is expected that a large contract for rifle cartridges for the British Government will be given shortly to Kynoch and Co., of the Lion Ammunition Works, Birmingham. The order will be sufficient to keep the works in full operation for several months.

Messrs. Sadler Brothers, firebrick manufacturers, Oldbury, who have for many years successfully competed for the contracts to supply the Government departments with fire materials, have again proved successful in obtaining a large contract order for the great Indian Peninsula Railway.

The electric light installation at Leamington, which has been laid down on plans supplied by Messrs. Chamberlain and Hookham, Birmingham, was officially set in operation on Tuesday. The concession for the lighting of the town has been granted to the Midland Electric Light and Power Corporation. The total number of incandescent lights ordered up to the present time is about 1500, but it is confidently anticipated that 5000, the number for which machinery has been laid down, will be wired in the course of twelve months. The massive machinery is of the most complete type. In order to give the necessary solidity it is bolted to a foundation consisting of 500 cubic yards of concrete and masonry. Three locomotive - type boilers, made entirely of Siemen's-Martin steel, are used to supply the engines. They have a total length of 19ft. 3in., with an external diameter of barrel of 5ft. 1in., and a total heating surface of 740 square feet. There are three pairs of large horizontal engines in all, each capable of exerting 200 effective horse-power, and designed and constructed especially for this installation by Messrs. Robey and Co., of Lincoln. The engines include the latest improvements in mechanical science, and form undoubtedly the finest and most symmetrical display of motive-power for permanent electric lighting machinery ever put down in this country. They are upon the compound principle, having high-pressure cylinders of 15in. and low-pressure cylinders of 26in. diameter respectively, the stroke of both being 2ft. 4in. The high-pressure cylinders are fittted with the Proell automatic valve gear, controlled by the Richardson electric governor. The electricity is generated by six Hookham patent dynamos, each capable of supplying 1000 incandescent lamps of 18-candle power each. Each dynamo weighs 72 cwt., and occupies a floor space of 8ft. by 5ft. The precautions against breakdown have been carefully worked out.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Except the slight fluctuations in price, which seem to be chiefly the result of speculative operations, there is no really material change to report in the actual condition of the iron trade in this district. Business continues to drag on slowly in much the same depressed fashion that has characterised trade for so long past, and there is still no really hopeful outlook in the future. In common pig iron makers have to go on seeking after business which is only practicable at unremunerative prices. Some of the hematite makers are apparently trying to bring about an improvement by lessening the output. Finished iron makers report a fair weight of business offering, but only at the lowest prices that have been ruling in the market recently. Trade as regards engineers and machinists also continues most unsatisfactory, and if anything there is an increasing keenness of competition to secure work which is forcing prices down even still lower.

There was about the usual attendance on the Manchester Iron Exchange on Tuesday, and the recovery in Glasgow and Middlesbrough warrants had, if anything, a tendency to steady prices somewhat, but so far as pig iron was concerned there was only a very slow business doing. For local and district brands prices remained practically unchanged. Lancashire makers still quoted 38s. 6d. for forge and 39s. 6d. for foundry, less 2½, delivered equal to Manchester, and for small local sales they hold to prices on the basis of these figures, but they would be prepared with some concession to meet buyers in a position to take anything like quantities; they are, however, doing comparatively little or nothing beyond their regular deliveries on running contracts. In some of the district brands there has been a small business doing at about 40s., less 2½, for Derbyshire foundry and 36s. 6d. to 37s., less 2½, for forge and foundry Lincolnshire delivered equal to Manchester, with sellers in some instances prepared to come a little under these figures rather than allow orders to pass. Scotch iron has not been offered at quite such low prices as last week, but it can still be bought at under makers' quoted rates, and although Middlesbrough is if anything steadier, it is difficult to get more than 40s. 6d., net cash, for the best named foundry brands delivered equal to Manchester.

The recent downward movement in hematite prices is again bringing forward the question of restricting the output, which has of late considerably overstepped requirements, and in some instances the blowing out of furnaces has already been decided upon, but trade itself remains without improvement, and buyers are not at all disposed to pay any higher prices. Hematite makers seem to have got into this position. By the largely increased make they have, on the one hand, forced up the value of the raw material they have to buy, whilst, on the other hand, by an excessive production they have depreciated the value of the iron they have to sell, which is certainly a very effective way of cutting off profits at both ends, and the only practicable escape out of the difficulty would seem to be in a reduction of the make, which, by a limitation of the demand for hematite ore, might enable them to buy their raw material on better terms, whilst the removal of an excessive output of hematite iron from the market might enable the makers to get better prices than have recently been possible. Delivered into the Manchester district the nominal quoted prices for good No. 3 foundry qualities are about 52s. to 52s. 6d., less 2½, and these figures some of the makers seem determined to hold out for, but where there has been business of any weight doing recently, 50s., less 2½, has represented about the full average price that has been obtainable, and it is questionable whether much above this figure could be got now. There is, however, so little business offering to test prices that they are practically little more than nominal.

There seems to be some considerable business in the market for finished iron, and when prices are low enough, I hear that there are buyers prepared to give out fairly large orders. To a considerable extent these are shipping orders, and in this branch of trade most of the makers are still being kept fully employed; but in the home trade generally there does not appear to be any really appreciable improvement. Delivered in the Manchester district the average basis of prices remains at about £4 17s. 6d. for bars, £5 5s. for hoops, and £6 7s. 6d. to £6 10s. for sheets.

The chief incident of general interest in this district during the past week has been the close of the Manchester Royal Exhibition. Of the several Exhibitions which have been held to commemorate the Jubilee year of her Majesty's reign, by far among the most successful and important has been the one organised in Manchester, and in fact it may perhaps claim in some respects a higher position than any Exhibition which has been previously held in this country. As an exposition on the one hand of the development of British art, and on the other of the industrial enterprise and the progress of invention in mechanics and engineering in England during the fifty years of her Majesty's reign, the Manchester Exhibition will rank as one of the most important among the many special efforts which have been put forward in celebration of the Jubilee year. The collection of British art productions has been unique whilst, the area devoted to exhibits of machinery has been more than half as much again as the combined space which was assigned in the three immediately preceding Exhibitions at London, Liverpool and Edinburgh, and even then was quite inadequate to meet the applications which were sent in by intending exhibitors. From the commencement to the finish, the Exhibition has been an unqualified success; for the first time in the history of Exhibitions it was in full working order on the day of the formal opening, and during the six months that it has since been open, everything has gone on smoothly, and, it may be said, generally satisfactorily. The number of admissions, which has amounted to very nearly five millions, has only been exceeded by the Colonial Exhibition held in London last year, and financially the results have been fully satisfactory. Not only has the entire cost of the building, amounting to something like £80,000, been completely cleared off, but even and above all the heavy expenses which have been incurred the executive will have a very handsome surplus to dispose of when it shall have been decided to what special object this surplus shall be devoted. Up to the present no really definite scheme has been put forward, either as regards the disposal of the building, or the surplus which the executive will have in their hands. Some time since, however, the suggestion was thrown out by Mr. Alderman Bailey, one of the members of the executive, that at any rate some portion of the funds which they would probably have in hand might be very properly devoted to the promotion of technical education in the district, and this is a suggestion which will receive support. As to the building, there is a pretty general feeling that some portion of it at least should be retained as a permanent structure, but for what purposes it should be retained, or how it should be utilised, there has not as yet been any really definite proposal. In connection with the Exhibition there are one or two special features that I may mention on the authority of the general manager, and which are interesting. Notwithstanding all the crowds which have visited the Exhibition—and they have been something phenomenal at times—there has not been a single instance of accidental or malicious injury, which is perhaps more than can be said of any other similar Exhibition. There has perhaps been no previous Exhibition which has received such support from local manufacturers in the direction of having things given or lent. All the boilers for generating the steam have been lent by Messrs. W. and J. Galloway and Sons, of Manchester, who are also the owners of the fairy fountain, which, it may be added, is going to Glasgow. All the engines for supplying the motive power, and all the belts, pulleys, shafting, and oil, have also been provided by the various makers, absolutely without charge of any kind, and in many other matters similar assistance has been received which has helped considerably in ensuring the financial success of the undertaking. The close of the Exhibition brings of necessity into prominence the question which is so frequently put, whether Exhibitions really serve the best interests of the exhibitors. There is little doubt that the multiplicity during recent years of Exhibitions of one sort or another has been a very considerable tax on engineers, machinists, and other firms who have incurred the heavy expense of exhibiting, and there is a very general feeling that, if anything, Exhibitions have of late been rather overdone. The experience of the Manchester Exhibition, although the expenses have been exceptionally heavy, would serve to indicate that the general results to the exhibitors for the outlay they had incurred, have not, at any rate, been unsatisfactory. In the important machine-making firms in the district it has proved a very valuable medium for meeting with foreign customers, and has resulted in the securing of a very considerable weight of business; machine toolmakers and pump makers, who have also been well represented, seem to have secured satisfactory results, and in many other branches of engineering and mechanical industry the Exhibition has been the means of stimulating trade either present or prospective, which cannot fail to be of considerable advantage to the district, whilst, through the Exhibition, Manchester itself and the surrounding neighbourhood has been brought into special prominence, which must certainly be of value in furthering the general interests of so important a commercial and industrial centre.

In the coal trade business is quiet; house fire coals are only moving off very moderately for the time of the year, and other sorts for ironmaking, steam, and general manufacturing purposes, continue bad to sell, plentiful in the market, and excessively low in price. At the pit mouth best coal averages 9s.; seconds, 7s. to 7s. 6d.; common house coal, 5s. 6d. to 6s.; steam and forge coal, 5s. to 5s. 6d.; burgy, 4s. 6d. to 5s.; and slack, from 2s. 6d. to 2s. 9d. for common, up to 3s. 6d. to 4s. per ton for some of the best sorts.

The shipping trade is still extremely dull, and ordinary qualities of steam coal continue to be offered at about 6s. 6d. per ton delivered at the high level, Liverpool, or the Garston Docks.

Barrow.—There is a much better tone in the hematite pig iron trade. The demand for hematite pig iron is much greater than it has been for weeks, and a good feature is to be found in the fact that the business doing by warrant holders is much less in bulk, while that doing by makers generally shows a marked improvement. This is also shown in prices, which this week are quoted a trifle higher. No. 3 forge iron is quoted at 43s. 3d. per ton net, f.o.b., and Bessemer iron in parcels of Nos. 1, 2, and 3 qualities moved at 44s. per ton. The tendency is in the direction of still higher values, and it is believed that the late figure of 45s. 6d. per ton will soon again be touched. One reason for this is the fact that the production of pig iron is being restricted. Last week a furnace was blown out at Workington. This week the Askham Company has blown one out. Some of the iron-producing companies in the Whitehaven district are about to follow the same example, so that probably by the end of the month the production of the district will be reduced by from 2000 to 3000 tons. This will doubtless act as a check against any reduction in prices, especially in face of the fact that the demand is more brisk than it has been, and the known requirements of consumers more considerable. Steel remains steady, and the demand is brisk for steel rails, bars, and billets, but the business doing in slabs is quiet, while no orders are offering for blooms. Sleepers have been fairly ordered, but the contracts now open are not considerable. Rails are rather cheaper, and are quoted this week for heavy sections at £4 1s. 3d. per ton net, f.o.b.; blooms, £3 17s. 6d.; billets and slabs, £4; wire rods, £5 15s. per ton. Shipbuilders are not better off for orders, although some important contracts are still pending. In the engineering trade there is rather more activity, but the works, generally speaking, are very indifferently employed. Iron ore is not so firm, and quotations are reduced to from 8s. to 10s. per ton net at mines. There is a prospectively good trade in native iron ore, however, as the value of Spanish qualities is now 12s. 3d. ex-ship in South Wales, and 13s. in Middlesbrough. Coal and coke enjoy a good sale, and the winter season is likely to be a good one, so far as the bulk of deliveries are concerned, with probably an advance in prices. Shipping has not been so brisk lately, but large cargoes of iron and steel have been sold for export.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE Yorkshire miners are now being summoned to hold pit-head meetings to appoint delegates to a county conference on the wages question, at Barnsley. The summons is signed by Mr. Benjamin Pickard, M.P., Mr. John Frith, and Mr. Wm. Parrott, the leading officials of the Miners' Association. The principal questions upon which the delegates will be asked to decide refer to the proposed limitation of output, by "playing" one day a week; and having, if necessary, further holidays to keep down stock. It is also proposed to clear off accumulations by "playing" a week before the plan of campaign in the colliery district is fairly commenced. A great conference is to be held at Newcastle, and the restriction of output will form the chief subject under consideration there.

A new railway is contemplated in this district. It will begin at Beighton, in Derbyshire, and proceed by Woodhouse, Killamarsh, Eckington, and Staveley to Chesterfield, thus developing the rich and fertile valley of the Rother. It will open up a colliery and iron district of great importance, and form a valuable feeder to the trunk line of the Manchester, Sheffield, and Lincolnshire Company, who are the promoters. Practically it is the route the sagacious George Stephenson selected for the old Midland line; and that his judgment was not in error is proved by the fact that in these later days the Midland has reverted to that route for its fastest trains between London and Scotland. The line, which will only be some ten miles in length and furnish no engineering obstacles, is to join the Midland at Chesterfield. It will develope a district in which the yearly output of coal is 2,000,000 tons. There is little doubt that the Midland Company means to take up the Dore and Chinley project, which was recently dropped for the moment by the local directorate. Probably the present promoters will apply for an Abandonment Bill, and the Midland Company will proceed to carry the line to completion. It will open up a beautiful district of country, and give Sheffield an alternative route to Manchester and Liverpool.

The information given in the THE ENGINEER last week in regard to ivory has been republished by the local papers here, and reappears in other journals. Since then it has been my privilege to inspect the ivory cellar of Messrs. Joseph Rodgers and Sons, the celebrated cutlery manufacturers. Their stock now includes a parcel of "Stanley" ivory, being part of the first consignment forwarded by Mr. H. M. Stanley, from the Congo. The ivory is of high quality, and there are hopes of a new source of supply being available. Several tusks were shown to me which had been "operated" upon by the natives, who are not novices in fraudulent trading. To increase the weight, quantities of lead, varying from 8 lb. to 12 lb., had been poured into the hollow of the tusk. The deception could not possibly be discovered until the tusks had passed through several hands and reached the workman. Then he made the discovery while sawing the ivory, probably snapping his saw teeth at the same time. The value of that class of ivory is about 12s. per lb., and the native therefore makes a good thing out of selling lead at that price. Messrs. Joshua Rodgers and Sons consume 25 tons of ivory per annum, including Gaboon, Angola, and Niger, East Indian, Cape, and Egyptian. The large tusks weigh from 50 lb. to 100 lb. each; middle from 25 lb. to 50 lb. each, and small from 3 lb. to 10 lb. The average weights used by the firm are 35 lb. Twenty-five tons contain 1600 tusks of this average, and as each elephant provides only one pair, it follows that at least 800 elephants per annum must fall for cutlery hafting and other purposes at Messrs. Joseph Rodgers and Sons' establishment.

There is again a decrease in the value of hardware and cutlery exported during last October, as compared with the corresponding month of 1886—the respective values being £264,155 and £242,420. The decreasing markets were Germany, France, Spain and Canaries, Foreign West Indies, Brazil, British North America, and Australasia. The increasing markets were Russia, Holland, the United States, Argentine Republic, British Possessions in South Africa and East Indies. Steel, unwrought, seems to be on the decline again. There was exported last month a value of £173,239, against £183,677 for October, 1886. For the first time the United States is responsible for the decrease—the value last month being £90,138, against £109,144 for October, 1886. France and other countries exhibit a slight increase. For the completed ten months of the year the value to October, 1887, was £1,812,289, against £1,159,228 for the corresponding period of 1886.

At the Mill Close lead mine, near Winster, an explosion of fire-damp took place last Friday. There were twenty-five men in the pit at the time, and of these five were killed and one injured. Hundreds of tons of soil were found by the exploring parties to have been hurled down in the workings. Dynamite cartridges were used in the mine for blasting purposes, and it is stated that in future the mine will be lighted by electricity. The cartridges are also to be manipulated by electricity, so as to reduce the chances of a repetition of the disaster. About 160 men were temporarily thrown out of employment, but on the completion of the work of restoring the ventilation, they were able to resume work this week. The Mill Close is a most prosperous concern, being one of the very few Derbyshire lead mines which now show a profit.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE attendance at the iron market held at Middlesbrough on Tuesday last was above the average; and though the amount of business transacted was small, indications were not wanting that the fall in prices has received a check. The prices current of No. 3 G.M.B. was 31s. 6d. per ton for prompt delivery. This is 3d. below what was accepted last week, but the same as was quoted on Friday last. Some makers are still willing to accept 31s. 9d. per ton, but in view of advancing prices at Glasgow, they are somewhat wary, and offer only small lots. There is but little doubt that Cleveland makers and merchants will both soon raise their prices should the advance be maintained in Scotland. Grey forge iron is in small request, and has fallen 3d. per ton during the week. It is now offered at 30s. 3d. per ton.

Stevenson, Jaques, and Co.'s current quotations: "Acklam Hematite," Mixed Nos., 44s. per ton; "Acklam Yorkshire," Cleveland, No. 3, 33s. 6d.; "Acklam Basic," 35s.; refined iron, 48s. to 63s., net cash at furnaces.

Warrants, which were 30s. 10½d. at the beginning of last week, fell at the end to 30s. 7d. On Tuesday they again advanced to 31s. 4d.

A decrease of 1911 tons has taken place in the stock of pig iron in Connal and Co.'s Middlesbrough store during the past week. The quantity held on Monday night was 325,312 tons. The decrease during October was 4349 tons.

The ironmasters' statistics for October were issued on the 3rd inst. They show that fifty-three furnaces were making Cleveland, and forty-two other kinds of pig iron. The output of Cleveland was 116,465, and of hematite, spiegel, and basic iron 105,299 tons, making a total of 221,764 tons, or 11,731 tons more than in September, when two more furnaces were at work. The stocks in the entire district amounted to 628,214 tons, which represents a decrease of 1314 tons during the month.

Since steel works first began to supersede ironworks, the workmen employed became liable to new kinds of accidents. These accidents generally arise either from the upsetting of large quantities of molten metal, or from the breakage of cranes, slings, chains, or other appliances used in lifting about masses heavier than were formerly dealt with. An accident of the latter class has just occurred at the Consett Ironworks. A young man, engaged as fireman upon one of the large self-moving steam cranes which serve the ingot pits, was engaged in lifting a heavy ingot, when the chain broke. In some way, which has not as yet been made clear, he was crushed to death between the crane and the bogie, which was being loaded. The chain had been in use for five years, and was believed to be abundantly strong. At the inquest the jury found a verdict of "Accidental death;" but at the same time they recommended that in future all chains used by the company for lifting weights should be periodically inspected and tested by competent persons, and that no workman should have access to any chains which had not passed through this ordeal.

A very pretty little quarrel is going on at the present time between the Redcar, Marske, and Saltburn Gas Company and its customers. The company obtained parliamentary powers several years since for the supply of Redcar and Coatham. It charged 5s. per 1000 cubic feet, with a rebate of 10 per cent. for cash. At the neighbouring town of Middlesbrough, however, gas is sold at 2s. per 1000ft. net, and with nothing extra for meter hire. Some time later the Redcar Company obtained additional powers to extend its pipes six miles to Marske and Saltburn. The extensions took place, and it is said that a great deal more money was spent than could possibly prove remunerative. Recently other gas companies in neighbouring towns have been reducing the price of gas to something like the Middlesbrough rate. This has stirred up the consumers at the towns on the coast to demand similar reductions from the Redcar Company. The latter have conceded to the extent of 4s. net, with meter hire extra, but refuse to reduce further. The consumers, however, demand a reduction to 3s. 4d. per 1000 cubic feet. If they do not get this, they threaten to do without gas altogether, and use petroleum. It is stated on good authority that the latter mode of lighting, although somewhat more troublesome, is really much cheaper than gas.

At Saltburn the Local Board have obtained an estimate for lighting the streets by electricity. They find that with an outlay of between £600 and £700 they will be able to illuminate the whole town at as low an average cost as they are now incurring for gas. Should the Redcar Company prove refractory, there is therefore every probability of their services being dispensed with throughout their whole district.

The North-Eastern Railway Company is continuing its policy of gradually renewing all the older and more inconvenient stations upon its line. It has just decided on superseding the present one at Haverton Hill, on the northern bank of the Tees, about two miles from Middlesbrough. Till recently the traffic at this point was quite insignificant, but the development of the salt industry in the locality has altered all that. The new station will be an "island" one, a most convenient type, and one which has been found relatively cheap, both in construction and in working. The alterations are to be commenced forthwith.

On the 3rd inst. a representative deputation from Stockton waited on the directors of the North-Eastern Railway Company at York, and endeavoured to impress upon them the necessity for rebuilding the present railway station at North Stockton. The latter is certainly awkwardly situated, inadequate to the traffic, and altogether out of date. After considerable discussion, the deputation were informed that the directors would take the matter into their serious and favourable consideration.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron warrant market has been subject to various fluctuations in the past week. Prices were down to the lowest point last week, but at its close they suddenly recovered 6d. per ton. A reaction took place on the issue of the Board of Trade returns, which showed a rather serious decline in the shipments during October. The prices again firmed up, however, and the state of the market is undecided. Were it not for the heavy stocks, it is held that prices might well advance materially from the present low level. The shipments in the past week were 8804 tons, as compared with 9234 in the same week last year. Of this quantity 2783 went to the United States, 824 to Italy, 750 to Germany, and 735 to Australia, there being no shipments to Canada. An additional furnace has been put in blast at the Govan Ironworks, and there are eighty-five in operation against sixty-nine at this date last year.

The current values of makers' pigs are as follows:—Gartsherrie, f.o.b. at Glasgow, No. 1, 46s.; No. 3, 42s. 6d.; Coltness, 50s. 6d. and 43s.; Langloan, 47s. and 44s.; Summerlee, 48s. 6d. and 42s.; Calder, 46s. 6d. and 40s.; Carnbroe, 42s. and 38s. 6d.; Clyde, 45s. and 40s.; Monkland, 41s. 6d. and 38s.; Govan, at Broomielaw, 41s. and 38s.; Shotts, at Leith, 46s. 6d. and 44s. 6d.; Carron, at Grangemouth, 49s. and 43s.; Glengarnock, at Ardrossan, 46s. 6d. and 40s.; Eglinton, 41s. and 38s.; and Dalmellington, 42s. and 38s. 6d.

The arrivals of Middlesbrough pigs in Scotland for the past week are 9078 tons, against 9296 in the same week of last year. In these imports there is an increase this year to date of 20,233 tons.

In the malleable iron branch there is more activity, for although foreign orders are still comparatively unimportant, the home demand has been improving. Merchant bars are quoted at £4 15s. per ton, less 5 per cent. Unmarked bars for the Indian market are quiet, but a number of orders for this description are still in course of execution. For scrap iron the inquiry is dull, but there is a little more appearance of business in the case of old rails, for which merchants are asking a little more money.

The Scotch steel makers are understood to have determined, at a private meeting held in Glasgow a few days ago, to resume the practice of charging for extras in connection with the rolling of boiler plates, their object being to restrict the size of the plates rather than to increase the cost.

There was shipped from Glasgow in the course of the past week a small steamer, valued at £1471, for Africa; machinery to the value of £10,100; sewing machines, £3695; steel goods, £8010; and general iron manufactures, £27,000, the latter including iron to the value of £12,800 for the harbour works at Batoum.

Several additional shipbuilding orders have been placed with Clyde firms, among them being that of a fast steel screw steamer, with triple-expansion engines to be constructed by Messrs. William Simons and Co., of Renfrew, for passenger service in the Mediterranean.

The shipping tonnage leaving the ports of Glasgow and Greenock in the ten months ending with October was 1,399,673, as compared with 1,347,297 tons in the same period of last year. In the ten months the arrivals were 1,156,699, against 1,081,534 last year.

Owing to the open weather, the household coal trade is limited, as compared with what it often is at the present season, but the past week's coal shipments are much larger than in several preceding weeks. From Glasgow, 31,181 tons were despatched; Greenock, 1861; Ayr, 9541; Irvine, 1604; Troon, 3902; Ardrossan, 3952; Burntisland, 17,319; Leith, 4780; Grangemouth, 15,885; Bo'ness, 4263; and Granton, 2058—the total of 96,346 tons comparing with 57,658 tons in the same week of last week. Free on board at Glasgow, main coals sell at 5s. 3d. to 5s. 6d. per ton; ell, 5s. 9d. to 6s. 6d.; splint, 5s. 9d. to 6s. 3d.; and steam coal, 7s. to 7s. 9d.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

IT is proposed to remove Dowlais Steel Works to Cardiff. The announcement that Lord Wimborne had concluded arrangements with the Marquis of Bute for the necessary land on the East Moors, Cardiff, has literally paralysed the district. In Cardiff the excitement is intense, as it will give them the very industry they want. Cardiff having simply a coal industry, is regarded as having a limited tenure of prosperity. In twenty years hence the Rhondda coal output will be very different to what it is now. No field, however vast, can stand the drain of 8,000,000 to 9,000,000 tons a year. Hence with a gigantic industry like Dowlais Steel Works added to Cardiff, other industries for the utilisation of "crop ends" of steel and waste would follow, and Cardiff become still more firmly based. Little is really known yet of the details, but it is well understood that Dowlais has been heavily handicapped in the make of steel. Mr. Menelaus, on the introduction of the Bessemer scheme, modified the plant to suit new requirements, and Dowlais did well in the infancy of steel. Cyfarthfa remained inert, but when it did make a move the Brothers Crawshay went in for new plant of the finest and best type, and the result is, are able to make steel at many shillings a ton cheaper than Dowlais can. The reason assigned for a move to the seaboard is heavy railway rates on Spanish ore and bad watershed.

In this column it has in former years been frequently questioned whether or not the future of the steel make in Wales would not be at the seaboard; but these arguments against it were adduced, namely, cheaper rent upon the hills, smaller wages required. Dowlais rents are about 3s. a week. Against this it is now urged that though house rent is much dearer at Cardiff, yet the class of house required has not been built, but can easily be. The whole movement is yet in its infancy, and as it elaborates I shall note the leading features.

The iron and steel works are certainly improving. Things are looking up in many quarters, and the re-start at Treforest Works and purchase of Mr. Fothergill's old works are good auguries. I hear also of other "Siemens works," but it is not yet developed sufficiently for notice.

The tin-plate trade is still hampered, and block tin at £132 is exercising a most pernicious influence. Several mills have been closed in addition to those I noted last week, and others are expected to follow. The tin-plate makers who have closed announce that they do so temporarily, until the price of tin is lowered. Quotations have been advanced from 12s. 9d. to 13s. 3d. and 13s. 6d. ordinary cokes, and other kinds in proportion, yet this does not meet the case or cover the proportionate cost. It is cheaper for makers to close than make—those who can afford to close. It is not likely that this "cornering" will have a long life, and the end to the speculators may be disastrous.

Trade at Swansea and in Monmouthshire is much affected this week. It has just been announced that two mills are closing in Pontardulais. Anything like a general suspension of work would settle the difficulty. Makers are debating which of the two evils is the lesser.

The management at Cyfarthfa was fined this week for an infringement of the Factory Act. The case seems to have been that certain directions for the protection of machinery have not been carried out.

A new safety lamp by Mr. Sandbrook, of Ebbw Vale, has been brought out, which is said to meet all needs. It is to be hoped that now the "Davy and Clanny" are under a cloud, a good lamp giving safety and an effective light will be brought to the front.

Movements in the proper course are being initiated, and this week the electric light was tried in firing a charge in the Standard, one of the Rhondda collieries.

At a meeting of the Sliding Scale on Monday, Sir W. T. Lewis in the chair, it was decided to continue the sliding scale unaltered for the present.

Work is being cut out for parliamentary committees, and three Bills may be named as very promising to the industries of Wales—first, the Cardiff and Monmouthshire line will again be brought forward; then a railway from Cwmdare to Hirwain by the Taff Vale, and the same company have another—a junction with their new line near Pontypridd, the Clydach.

Various rumours with regard to the management of the Bute Docks by the Taff are in circulation, but I am unable to trace them to any trustworthy source, and may well be discarded until official information is given.

Coalowners are hopeful that with the improvement in iron and steel the much-needed change for the better in general industries will follow, and coal, as usual, benefit. It is still somewhat depressed. Some of this is due to the storms which have had a bad effect on the tonnage coming in at all the ports. Later on in the week, with improved weather, things have begun to look better, though prices remain unaltered. Steam coal is selling at 8s. to 8s. 6d. at Cardiff, 6s., 6s. 3d., to 6s. 6d. at pit's mouth. Rhondda coal is tolerably firm at 8s. 3d. Coke remains the same—14s. ordinary thirds. Pitwood is not so firm.

At the Exchange, Swansea, on Tuesday, sales of tin-plate were reported at even 1s. and in some cases 1s. 6d. per box advance. The trade done was necessarily limited.

In rails nothing was offered under £4 5s., and light colliery sections £5; Bessemer blooms, £4 5s.; bars, £4 15s.; Siemens bars, £5 2s. 6d.

Latest offers of tin-plates ordinary, 13s. 9d.; latest price block tin, £132. Stock of tin-plate on hand in Swansea, 68,000 boxes.

Cargoes of coal were sold this week at Cardiff, in the hulks of wrecked vessels, for 3s. 6d. and even more per ton. This is promising.

The Mountain Ash colliers have finally decided to establish reading-rooms.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

THE position of the iron markets continues good, and the final establishment of the wrought iron convention, to which the S.W. group of rolling mills has now given in its adhesion, has had the effect of not alone improving the position of those works directly participating in its benefits, but has been favourably received by the crude iron market as well, as, for instance, in Silesia, where the raw iron market evinces a very firm tendency, where the sales continue satisfactory, the rolling mills and forges well employed, and wire rods in particular are tending strongly upwards. This is satisfactory in face of a review of all the other iron markets, where, with the single exception of Belgium, the conditions are less favourable than they were. In France the old war continues to wage unweakened between buyers and producers, which entirely cripples a healthy development of the trade.

In Rheinland-Westphalia iron ores are slightly weaker in price, not from slackened demand, but because of a superabundant output, which usually occurs in the winter months. In Luxemburg, on the other hand, a slight rise in red minette from M. 1·80 to 2·00 has taken place within the fortnight, and the other sorts are firm at former quotations. If Westphalia is to successfully compete on the international market, it appears to be a *sine quâ non* that the works should be able to procure these cheap oolite ores for their mixtures in the blast furnaces, so, as usual, the State is being bombarded to institute lower railway rates, in order the better to accomplish this.

The trade in pig iron is firm, if in some sorts a little quieter. The State has introduced lower rates for the carriage of raw iron from the Siegerland when for export, and the Dutch railways have done the same, all of which should benefit foreign buyers of spiegeleisen, which is still in good demand for home use, but not in quite such good request for abroad. The prices remain firm and un altered from last quotations.

Puddling pig continues in steady request at former prices, and contracts for next quarter are being entered into. There is a little better demand for foundry iron, and stocks are being reduced faster than a short time back. In Bessemer and basic pig the condition is unchanged, and it has been possible to sustain prices during the week, as last quoted.

The forges and rolling mills are still satisfactorily engaged. A polemic has already begun in the trade journals between the dealers and producers regarding the great wrought iron convention, which is rather entertaining. At any rate, it is too soon to form a just opinion; it must be allowed time to show what it can do, and more especially in times when the trade is less buoyant than just now; so far all has gone on well, and with the new year it sees its way to declare a rise in bars of M. 5 from 115 to 120 p.t. as base price. The main idea is to adapt production to consumption, and the price to that of the raw materials, and if this can be effectually carried out in all circumstances there is no reason to doubt that it will be beneficial to all concerned and succeed. Plates remain in steady, if not large, request, but sheets are, as ever, in the fullest demand and prices very firm; indeed, they have been raised M. 5 p.t. since the Rhine, Ruhr, and Siegerland works on the 2nd inst. signed their new convention statutes. Hoops are quieter, and the late prices could not be well sustained. There is no change to note in the wire rod branch, either in price or demand; an improvement, however, is looked forward to when the wire nail convention becomes a *fait accompli*. In railway material M. 115 was the lowest tender at Berlin for 2430 t. of rails and M. 117¼ for 900 t.; for sleepers, M. 122, and for fish plates, 97·90, and under plates 102 per ton. At the Bromberg tendering, mentioned last week, it turns out that a second English firm—the Darlington Iron and Steel Works—did make an offer at M. 119·50, free at Neufuhrwasser, but whether this will be the lowest tender depends on which railway station the rails are ultimately to be delivered at, most probably, however, the native works will receive the order. At Breslau, 8500 t. were tendered for at M. 122 per ton; sleepers at Erfurt at 125; fish plates at 103·50; and under plates at 113·50 per ton. Wheels and axles, the set at 308 and 310. The wagon works are thirsting for orders, but some of them will now have employment, for Berlin gave out on the 3rd 345, and Cologne, on the 7th, 690 of different sorts, and more are in prospect. In consequence of the rise in raw materials the prices of the wagons have also advanced a little—for instance, from M. 7200 7500, at Magdeburg, to 8800 at Bromberg, as lowest offers for the same kind of wagons. It is the stereotype report as regards the machine, boiler shops, and constructive ironworks in general satisfactory employment, but at low prices by far in comparison to wages and raw materials. The brass founders were exceedingly well engaged during October, and in the latter half of the month prices became a little more remunerative. Orders are in hand for the next two to three months. There is now no export trade to Russia an account of the high duties, but France and Belgium are new giving employment to the German brass foundries.

It was mentioned in this place three months back that the first chain cable factory had been set to work. The results have exceeded expectations, and six new fires have lately been added to the twelve already at work, and ten more are shortly to be started. Whether the long strike in Staffordshire had anything to do with the conception of this new branch of industry here is not easy to determine; but one thing is clear, that if such strikes should often occur again, England cannot expect to continue to have the monopoly of the heavy chain trade abroad which it has had much longer, in the face of the establishment of more such new works on the Continent.

The new plan for improving the present depressed condition of the Westphalian coke and coking-coal trade is the formation of a limited company of the mines and works concerned, with its seat at Bochum and a capital of 1½ million, to be raised if need be to 2½ million of marks, in M. 1000 shares. Its duration is fixed at five years, to be prolonged from five years to five years if further agreed. From January 1st, 1888, the output of the mines and ovens will be regulated and sold by the company, and from that date the prices have been fixed as follows:—Coking-coal, sieved and in a dry condition, M. 4 p.t.; washed ditto, 4·40; blast furnace coke, 7·50; foundry, 8·50; patent ditto in lumps or machine broken for founders' use, 9·00; sieved coke, 20 mm. cube, 6·00; pearl coke, 10 mm. to 20 mm. cube, 3·00. The dry coking-coal above 6 mm. cube is not to contain more than 9 p.c. of ashes; washed ditto at most 6 p.c. ashes and 10 p.c. of water; coke is not to contain more than 12 p.c. ashes and water.

The news from Bilbao is that for some weeks past the ore market has been animated. Particularly from the iron centres in England have the inquiries been brisk for best qualities, but that the mine-owners do not seem disposed to contract for next year at 6s. 9d. p.t. In comparison to last year the shipments this autumn have been very lively, and last week not less than 70,000 t. were exported, and it appears the competition of English capitalists is causing alarm in some quarters, as it is known that some are making every endeavour to acquire the right of exploiting some of the best Swedish mines. The present price of Campanil ore is quoted 7s. to 7s. 3d., and best red ore at 6s. 7d. to 6s. 10d. p.t. From January 1st to October 22nd, 3,546,227 t. have been shipped, against 2,577,173 for the corresponding period of last year.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, Nov. 5th.

THE American tin market has been excited all the week, owing to London cables. Prices have slightly advanced, and the jobbing trade has been checked. Spot stocks at coast ports and afloat foot up 2300 tons. The consumption this year, so far, has been 10,150 tons, against 9700 tons for the same time last year. Tin-plates are rather dull. The heavy purchases made at this season of the year are postponed. Importers and dealers are quite confident that prices will fall, and that a full demand will be presented before the middle of November. Copper is stronger than a week ago, and is quoted at 10·35 dols. The export since January 1st is 9,811,469 lb., as against 14,693,433 lb. for the same time last year. The lead market is quoted at 4·30; sales for the week, 1000 tons.

The American iron market is weak, with prices at 21 dols. for No. 1 foundry, 19 dols. for No. 2, and 17 dols. for grey forge. Blooms are 30·50 dols.; spiegeleisen, 27 dols. for 20 per cent. English. Steel rails are 35 dols. to 36 dols.; old rails, 22 dols. to 22·50 dols.; foreign Bessemer, 20 dols.; American, 19 dols.; merchant iron, 2c. per lb.; tank iron, 2·50; fire-box, 4c. There is a heavy distribution of iron and steel products throughout the country, owing to the usual preparations made at this season for the winter's consumption. An immense amount of bridge building has been prepared for. House, shop, and mill building will be prosecuted with a good deal of activity this winter. The money markets are easy, but there is a probability of stringency farther along, and shrewd financiers are adjusting their affairs for it. Railroad earnings are satisfactory; while shipments from Chicago to New York have fallen off, local traffic has made up for it. The anthracite coal strike, involving 20,000 men, continues.

The heavy importation of foreign material is causing American iron manufacturers a good deal of concern. The imports for September were 120,085 tons. Of this, 44,590 were pig iron, 22,790 tons were steel rails, and 24,495 tons were tin-plates; total importation for the nine months was 1,041,750 tons. The conditions of the iron and steel markets of this country are not satisfactory to all parties concerned. It is more difficult now to obtain money for railroad building than six months ago. The impression prevails that we are overdoing in this direction. In other channels activity is increasing. There is a heavy demand for nearly all kinds of merchant steel. Tool and implement works are quite busy. Bridge works are overcrowded with orders. Car works are unable to meet all demands. At the same time, the iron trade of this country is not threatened by an immediate depression. The legitimate requirements for the next twelve months will be heavy. The financiers of the country are strong. Failures are few. The business interests are comparatively free from debt, and the population is expanding throughout the West and South, thus establishing new markets. Foreign material is under active inquiry. Bessemer pig is worth from 20 dols. to 21 dols.; manufactured iron, 2c. to 2·10c. for refined. All kinds of crude iron are selling well, and the full production is being promptly marketed. Stocks are lower than for two years.

A great deal of furnace capacity will be ready for blowing early in the spring. Southern furnaces are doing quite well, finding active local markets for their products. Foundries, machine shops and other industrial iron-consuming establishments are springing up in the South. So far this year 2600 new industrial establishments of all kinds have been erected in the fourteen Southern States. This is phenomenal activity, and there are no indications of an early subsidence, consequently Northern machine shops and foundries, which are contributing material, are confident of twelve months' additional activity. Steel rails are 34 dols. at mill. Old rails 22 dols. at tide water. The entire iron outlook of the United States is more favourable than for many months. The anthracite coal strike still continues, and 20,000 men are idle. Prices have been advanced three times and consumers are very urgent for winter supplies. The Connellsville coke output is about 95,000 tons per week. Cars are scarce and consignees are complaining about slow deliveries.

NEW COMPANIES.

THE following companies have just been registered:—

Lancashire and Yorkshire Patent Hydraulic Freestone Company, Limited.

This company proposes to manufacture freestone, under letters patent No. 4927, dated November 10th, 1881. It was registered on the 27th ult., with a capital of £20,000, in £5 shares. The subscribers are:—

	Shares.
Wm. Hill, Urmston, merchant	1
J. Clarke, Bebington, architect	1
F. N. Railton, Alderley Edge	1
W. H. Hayes, Urmston	1
Hugo Shaw, Lees, near Oldham, earthenware manufacturer	1
E. Moody, Old Corn Exchange, Manchester, commission agent	1
Herbert Birch, Chapel-en-le-Frith, agent	1

Registered without special articles.

Armstrong's Electric Light and Power Company, Limited.

This company was registered on the 2nd inst., with a capital of £20,000, in £1 shares, to acquire the business of electrical engineers carried on by James Tarbottom Armstrong. The subscribers are:—

	Shares.
J. T. Armstrong, 145, Bermondsey-street, electrical engineer	1
*C. King, Parliament Mansions, engineer	1
*Captain C. D. Inglis, R.N., 101, Warwick-road, Earl's Court	1
*R. J. Sankey, 31, Aldermanbury, merchant	1
*F. R. Pike, 20, Treberri-road, Earl's Court	1
*W. Bellingham, 15, Streatham-hill	1
J. S. Blease, 39, Cathcart-road, S.W.	1

The number of directors is not to be less than two, nor more than seven, the first being the subscribers denoted by an asterisk; qualification, £250 in shares; remuneration, such sum, not being less than £500 per annum, as the company in general meeting shall determine.

Clamond Incandescent Gas Light Company, Limited.

Registered on the 29th ult., with a capital of £200,000, in £1 shares, to acquire the patent rights and interest of Robt. Tyndale Haws and Wm. Thompson, in an invention for incandescent lights, known as the "Clamond Incandescent Burner." The subscribers are:—

	Shares.
E. T. Read, 80, Lombard-street	1
E. P. Rogers, 37, Walbrook, commission agent	1
E. H. Chandler, Watford	1
R. T. Haws, Kenley, Surrey	1
W. A. Turner, 76, Coleman-street, accountant	1
W. Scotland, Richmond	1
R. A. Hoffman, 14, Haverstock-street, Islington, accountant	1

The number of directors is not to be less than three, nor more than seven; the subscribers are to appoint the first; qualification, £200 in shares; remuneration, £200 per annum each, with an additional £100 per annum for the chairman, and one-tenth of all profits available for dividend after 10 per cent. has been paid.

Engine Company, Limited.

This company proposes to acquire several letters patent granted to Henry Hermann Westinghouse, Arthur George Brown, Harris Tabor, and Stephen Alley, in connection with engines, together with all the Westinghouse engines in course of manufacture by Messrs. Alley and MacLellan in the Sentinel Works, Polmadie, Glasgow, and all plant and machinery provided for the manufacture of the said engines, and the rights of the said firm as to manufacturing and selling the Westinghouse engine. The company was registered on the 2nd inst., with a capital of £100,000, in £10 shares. The purchase consideration is £35,000, payable—£10,000 in cash and the balance in fully-paid shares. The subscribers are:—

	Shares.
J. M. MacLellan, Polmadie, Glasgow, engineer	1
*Sir J. H. Mackenzie, Bart., 62, Redcliffe-square	1
*J. M. Stobart, Spring Vale, Ryde	1
*W. Duff Bruce, 8, Champion Park, Denmark-hill	1
*J. W. H. James, 9, Victoria-chambers, Westminster	1
*J. D. Gibbs, 18, Warwick-street, Regent-street	1
S. Alley, Polmadie, Glasgow, engineer	1

The number of directors is not to be less than three, nor more than seven; qualification, £250 in shares or stock; the first are the subscribers denoted by an asterisk, and Mr. H. W. Westinghouse; remuneration, £800 per annum.

Gelatinous Cartridge and Safety Lamp Company, Limited.

Upon terms of an agreement of the 20th ult., this company proposes to purchase the letters patent No. 2123, dated February 13th, 1886, for an improved lamp for blasting and shot-firing in mines; and also the letters patent No. 5222, dated April 14th, 1886 for an improvement in blasting cartridges—both of which were granted to John Heath and Wm. Frost. The company will also acquire all foreign and colonial patents granted for the said inventions, and for any improvements thereon. It was registered on the 27th ult., with a capital of £25,000, in £10 shares. The purchase consideration is £1500, of which £500 is payable in fully-paid shares. The subscribers are:—

	Shares.
*Wm. Woodall, M.P., Burslem	15
*R. Heath, jun., Greenway Bank, Staffordshire, ironmaster	15
*W. Heath, Burslem, colliery proprietor	15
*J. Lovatt, Newcastle, Stafford, army clothing contractor	15
D. Munro, M.E., Newcastle, Stafford	15
Robt. Lucas, M.E., Hanley, Stafford	15
H. A. Fellwright, Burslem, colliery proprietor	15

The subscribers denoted by an asterisk are the first directors; qualification, fifteen shares; remuneration, £50 per quarter.

Oppermann Electric Lighting and Manufacturing Company, Limited.

This is the conversion to a company of the electrical business carried on by Mr. T. J. Oppermann, trading as Lawrence Oppermann, at the Crown Works, Amherst-road, Hackney. It was registered on the 1st inst., with a capital of £20,000, in £5 shares, with the following as first subscribers:—

	Shares.
*Lord Edward Spencer Churchill, Moreton-in-Marsh	1
*Alex. Wm. Hall, M.P., St. Thomas, Oxford	1
*Rev. Hy. Barter, Shipton-under-Wychwood, Oxon	1
Charles Barter, Shipton-under-Wychwood, Oxon, electrical engineer	1
H. Montague Spence, Moreton-in-Marsh	1
H. N. Warburton, Winchester, electrical engineer	1
C. T. J. Oppermann, Crown Works, Hackney, electrical engineer	1

The number of directors is not to be less than three, nor more than seven, the first being the subscribers denoted by an asterisk; qualification, £25 in shares; remuneration, £100 per annum.

South Wales Explosives Company, Limited.

This company was registered on the 31st ult., with a capital of £50,000, in £10 shares, to trade in explosives of all kinds, and also in chemical and general mining and quarrying appliances. An unregistered agreement of August 31st, between James Thornes, Ed. Kraftmier, and Thos. Johnston of one part, and F. C. Bourne of the other part, will be adopted. The subscribers are:—

	Shares.
J. C. Taylor, Kingston Hill, broker	1
J. R. Pedler, Wood Bank, Dulwich	1
J. Wilson, 9, Edenbridge-road, South Hackney	1
C. M. Westfield, Upper Clapton	1
C. R. Graham, 70, Wharton-road, Kensington	1
R. W. Cox, Southend, Essex	1
A. Hille, 93, Leconfield-road, Canonbury	1

The number of directors is not to be less than three, nor more than five; the subscribers are to appoint the first.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

1st November, 1887.

14,839. FOOTBALLS, F. H. Ayres and A. Foster, London.
14,840. SELF-ACTING BILLIARD BALL MESSENGER, T. Ritchie, Newtown.
14,841. DOBBY HORSES, J. Broxup, London.
14,842. HORSE BIT, F. E. Jones, Birmingham.
14,843. WASHING, &c., D. Stewart and R. Walker, London.
14,844. WATERPROOF BAGS, J. A. and C. Stewart, Glasgow.
14,845. SELVEDGE MOTION, T. Blezard and W. Nelson, Padiham.
14,846. BEARINGS for SHAFTING, J. R. Lucas, Birmingham.
14,847. PREVENTING DRAUGHTS UNDER DOORS, B. and C. H. Townend, Halifax.
14,848. TOBACCO PIPES, H. N. Boyd, Manchester.
14,849. WIRE STRAINING, J. McLeish, Knock, Co., Down.
14,850. TREATMENT of WORSTED TOPS, &c., J. Lodge, Huddersfield.
14,851. STONE DRESSING MACHINERY, J. Coulter, Halifax.
14,852. FLEXIBLE and METALLIC STAMPS, J. Jackson, Birmingham.
14,853. GRAIN SAVING DEVICES, A. J. Boult.—(*The Milwaukee Harvester Company, United States.*)
14,854. COVERS for SHIPS' BOATS, &c., W. J. Gell, Liverpool.
14,855. PRESSES for HOPS, W. Davis and W. Winterbottom, Manchester.
14,856. WATERPROOF COATS, E. E. Williams, London.
14,857. FURNACE for BURNING OFFENSIVE SUBSTANCES, A. Engle, London.
14,858. FASTENER for CORSETS, &c., F. Beauchamp, London.
14,859. PORTABLE CAMERA STAND TOP, W. Rowland, London.
14,860. TYPE WRITING MACHINES, W. R. Lake.—(*A. W. Cash, United States.*)
14,861. CLOTHES PEGS, H. Buttermilch, Liverpool.
14,862. STEAM ENGINES, J. J. Campbell, Liverpool.
14,863. BRONCHIAL KETTLES, H. H. Mason, London.
14,864. DISINFECTANT SUBSTANCES, W. B. Giles and A. Shearer, London.
14,865. STRANGLE JOINT, A. Hall, London.
14,866. REGULATING GAS BURNERS, J. G. Hawkins and J. Barton, London.
14,867. CONNECTING PEDALS to VELOCIPEDES, J. Keen, London.
14,868. MIRRORSCOPE REFLECTOR LIGHT, W. H. W. Foster, London.
14,869. RAILWAY WHEELS, J. Y. Johnson.—(*W. Sellers, United States.*)
14,870. CASTING STEEL WHEELS, J. Y. Johnson.—(*W. Sellers, United States.*)
14,871. INTERNALLY HEATED STEAM GENERATORS, J. Y. Johnson.—(*G. H. Sellers and W. Malam, United States.*)
14,872. CONDENSERS, F. J. Burrell, London.
14,873. BUSTLE, S. Sharp, H. S. and R. N. Perrin.—(*F. J. P. Tommins, United States.*)
14,874. EMBROIDERING FRAMES, &c., R. Voigtländer, London.
14,875. CRUSHING CLAY, P. S. Larsen, London.
14,876. STEAM BOILERS, J. Lepper, London.
14,877. CONDENSING STEAM, O. P. and W. Gray, London.
14,878. PUZZLE-PURSE or POUCH, R. Kingston, London.
14,879. TRANSMITTING MOTION by BELT or BAND, A. T. Booth, London.
14,880. LUBRICATORS, F. Buschmann, London.
14,881. TEMPORARY STRUCTURES suitable for COTTAGES, &c., D. Nicoll, London.
14,882. SECURING HAIRS, &c., upon FOUNDATIONS, G. Lightenfield, London.
14,883. TREATMENT of SACCHARINE, A. and L. Q. Brin, London.
14,884. TREATMENT of SACCHARINE, A. and L. Q Brin, London.
14,885. MAGAZINE or REPEATING RIFLES, W. R. Lake.—(*The Colts Fire-arms Manufacturing Co (Incorporated), United States.*)
14,886. MACHINES for CUTTING PAPER into STRIPS, S. Wheeler, London.
14,887. SHIPS' YARDS, D. Campbell, London.
14,888. BOTTLE and LABEL PROTECTOR, A. Grisi, London.
14,889. HYDRAULIC HOISTING MACHINERY, J. Stannah, London.
14,890. SELF-CLOSING VALVES, S. Malo y Valdivielso, London.
14,891. PENS for WRITING PURPOSES without ORDINARY INK, S. Malo y Valdivielso, London.
14,892. LUBRICATORS for STEAM ENGINES, W. R. Lake.—(*N. Seibert, United States.*)
14,893. GENERATION of ELECTRICITY, L. G. Woolley, London.
14,894. TRANSFORMERS, J. M. V. Money-Kent and S. Sharp, London.
14,895. PIPES for SMOKING TOBACCO, O. Grappin-Dalloz, London.
14,896. PRINTERS' GALLEYS, E. Lloyd, London.
14,897. ARTIFICIAL GRANITE, P. von Krystoffovitch, London.
14,898. CONVERTIBLE RIDING SADDLE, W. H. Page-Nash, London.

2nd November, 1887.

14,899. BOOT LAST for WINDOW BOOTS, A. Savage, London.
14,900. FALL DOORS for STOVE GRATES, D. G. Davy, Rotherham.
14,901. ELECTRIC BATTERIES, C. R. Goodwin, Paris.
14,902. AUTOMATIC WATER LEVEL INDICATORS, J. Barr and W. McWhirter, Glasgow.
14,903. DOMESTIC OIL LAMPS, W. Devoll, Erdington.
14,904. DISTRIBUTING GOLD and other ORES, C. W. Kitto, London.
14,905. BOX for CUTTING PLATES of RAG ENGINES, J. Teather, Sheffield.
14,906. PRODUCTION for PHOSPHORUS TRICHLORIDE, C. Fahlberg, London.
14,907. PREVENTING RACING in MARINE ENGINES, B. Dadley, London.
14,908. NEEDLE THREADER, J. Handley, Manchester.
14,909. SPRINGS for BOBBINS, C. Sipman, Nottingham.
14,910. CURTAIN HOLDERS, &c, G. W. Herbert, Birmingham.
14,911 GAS ECONOMISER, J. M. Wilkinson, Newport.
14,912. SELF-ADJUSTING SPANNER, W. Dampier, Flintshire.
14,913. CARRIAGE SPRINGS, L. Peets, Manchester.
14,914. HOT AIR DRYING SYSTEM incorporated into CHAMBER KILNS, F. H Jung, Parkstone.
14,915 SIGHTING APPLIANCES for ORDNANCE, J. O'Kelly, London.
14,916. DUMMY CARTRIDGE CASE and EXTRACTOR, J. O'Kelly, London.
14,917. HEATING GLUE, &c., W. E. and J. H. Weston, Leicester.
14 918. STUFFING BOXES, I. B. Harris, Glasgow.
14,919. SAFETY SHADE LAMP, G. J. Preston, Antrim.
14,920. PERAMBULATOR SUNSHADES, T. F. Harris, Brighton.
14,921. COMBINED MAGIC LANTERNS, J. Battersby, Liverpool.
14,922. CUTTING-OFF STEAM for SLASHING MACHINES, J. Taylor, Blackburn.
14,923. COAL WAGONS for RAILWAYS, G. Taylor, Penarth, near Glasgow
14,924. RECORDING SPEED of ENGINES, E. E. Wigzell, London.
14 925. BLOCKS of ICE, G. F. Fawcett and M. C. Bannister, Liverpool.
14,926. LOOMS, W. P. Thompson.—(*F. Belluschi, Italy.*)
14,927. OBTAINING a CONTINUOUS QUANTITY of CARBONIC ACID or other GAS, L. and C. Guéret, Liverpool.
14,928. PLUMMETS, G. Green, London.
14,929. APPLYING an AUTOMATIC WORKING-MODEL to CHARITABLE CONTRIBUTION BOXES, J. L. Featherstone and R. Milbourne, Chingford.
14,930. GAS-PRESSURE REGULATORS, I. Botibol, J. Mangnall, and E. Stargardt, Manchester.
14,931. AIR-TIGHT FURNACE and RETORT DOORS, J. J. Miller, G. J. Tupp, and H. G. A. Rouse, London.
14,932. STRAP FASTENER or BUCKLE, W. H. Hall, London.
14,933. RECORDING the SALE of PARCELS of GROCERIES, H. Kershaw, London.
14,934. OBTAINING MOTIVE POWER, J. Thompson, London.
14,935. SELF-REGISTERING THERMOMETER, P. Tufnail, London.
14,936. COMBINED BOTTLE and DRINKING VESSEL, D. Jones, London.
14,937. MEASURING INSTRUMENT, G. A. Hansson, London.
14,938. COMBINED TEAPOT and CADDY, H. M. Barron, G. Nash, and J. C. Kent, London.
14,939. GAS COCK, T. Foster, Manchester.
14,940. FIRE ALARMS, F. G. Wright, London.
14,941. OPENING BOTTLES, H. Barrett and J. J. Varley, London.
14,942. MOUNTING CENTRE BOARDS for SAILING VESSELS, G. G. M. Hardingham, London.
14,943. REGULATING the ACTION of HEATING APPLIANCES, P. J. Grouvelle, London.
14,944. CLOSING CAPSULES of SOFT METAL, W. Pittner, London.
14,945. FOOD for ANIMALS, N. P. M. Tronson, London.
14,946. EXTINGUISHERS for OIL LAMPS, F. W. Durham, London.
14,947. SOUND-PRODUCING HORN, S. M. y Valdivielso London.
14,948. FLOATING LAMP, S. M. y Valdivielso, London.
14,949. VESSEL for PRESERVING FOOD, S. M. y Valdivielso, London.
14,950. MILLSTONES, C. J. Potter, London.
14,951. PRINTING upon POTTERY, T. Minton, H. Minton-Senhouse, H. M. Robinson, J. Clegg, and J. Lea, London.
14,952. GAS ENGINES, A. Schmid and J. C. Beckfeld, London.
14,953. BILLIARD TABLES, J. Warby, London.
14,954. DEPOSITION of METALS, W. Terrill, London.
14,955. SYPHON FLUSHING CISTERNS, D. T. Bostel, London.
14,956. URINALS, D. T. Bostel, London.
14,957. APPARATUS for RECREATIVE PURPOSES, C. Noble, London.
14,958. VENT PEG, C. Windust, London.
14,959. INKING PAD for HAND STAMPS, E. M. Richford, London.

3rd November, 1887.

14,960 DUPLICATE DRIVING BAND, F. J. B. Duff London.
14,961. RECEPTACLES for CONTAINING INKS, &c., H. J Harman, London.
14,962. WHEEL TIRES, C. E. Stretton, Leicester.
14,963. ATTACHMENT for CARRYING PARCELS, &c., H. A. Done, Sutton Coldfield.
14,964. PARAFFINE OIL SAFETY LAMPS, G. T. Tugwell, Burgess Hill.
14,965. AXES, &c., J. Guest, Birmingham.
14,966. ANCHORS, J. and E. Ford, and W J. Cox, Birmingham.
14,967. CARDING ENGINES, T. S. Whitworth, Manchester.
14,968. FIRE-BRICK and BURNER, A. F. Emery, Birmingham.
14,969. INDIA-RUBBER SOLES for BOOTS and SHOES, H. Markus, Manchester.
14,970. FLOCK-MAKING MACHINES, J. Illingworth, Halifax.
14,971. BRACES or SUSPENDERS, J. W. Seddon, Manchester.
14,972. APPARATUS for ATTACHING to STREET CARS, J. Rhodes, Birmingham.
14,973. VENTILATING BUILDINGS, P. M. Justice.—(*G. Kesselring, Italy.*)
14,974. WEARING APPAREL, R. Brough, Birmingham.
14,975. FEED ROLLERS, E. Gaunt and W. Firth, Bradford.
14,976. STOVES or GRATES, R. H. Quine, Manchester.
14,977. BALE, &c., FASTENINGS, A. Gardner and C. Simon, Manchester.
14,978. EXTINGUISHING APPARATUS for LAMPS, F. R. Baker, Birmingham.
14,979. BATH CHAIR, G. R. Davies, Leamington Spa.
14,980. WORKING MOVABLE ADVERTISEMENTS, G. E. Skliros, London.
14,981. SPRING and LEVER CLUTCH and SAFETY BOLT, C. M. Davis, Kimberley, Cape of Good Hope.
14,982. TREATING SEWAGE, F. A. Hillé, London.
14,983. BLOW-PIPES, T. Gare, Stockport.
14,984 BEARINGS for SHAFTS, T. Gare, Stockport.
14,985. FLEXIBLE SHAFTS, T. Gare, Stockport.
14,986. MIXING EGGS, &c., A. Buckley and J. E. Bickerton, London.
14,987. GOVERNORS for ENGINES, W. J. H. Fresen, London.
14,988. VENT PEG, E. P. Yates, London.
14,989. DISENGAGING HOOK, H. Stanning, London.
14,990. METALLIC COVERING, J. Knight, London.
14,991. RAILWAY STATION INDICATORS, D. T. Powell, London.
14,992. PRODUCING ARTICLES from FLUID METALLIC METAL, W. P. Simpson, London.
14,993. FOUR-WHEELED CARRIAGES, H. Smith, London.
14,994. PULLEYS, A. E. H. Field, London.
14,995. LOCOMOTIVE TOYS, F. H. Ayres and E. Grimsdell, London.
14,996. GEAR for ELECTRIC MOTORS, E. Hopkinson, London.
14,997. TREATMENT of ALKALI WASTE, J. Hanson, London.
14,998. GRINDING CUTTING TOOLS, A. Gray, London.
14,999. PURIFICATION of AIR, A. Angell and F. Candy, London.
15,000. TELESCOPIC HYDRAULIC LIFTS, D. Thomas, London.
15,001. FASTENER for GLOVES, J. D. Hickman, London.
15,002. VENTILATING CLOSETS, H. Reinicke, London.
15,003. GAS RETORT LIDS, J. G. Hawkins and J. Barton, London.
15,004. SWITCH-BACK RAILWAYS, R. H. Bishop and J. F. Phillips, London.
15,005. MANHOLE COVERS, P. Mitchell, London.
15,006. ELECTRIC SWITCH, R. Butcher and E. Rousseau, London.
15,007. HORSESHOES, &c., N. B. Blaize and L. Arbez, London.
15,008. FIRE-EXTINGUISHING, W. Brandt, London.
15,009. GAS-RETORT FURNACES, H. W. P. Nugent, London.
15,010. IGNITION APPARATUS, F. W. Crossley and F. H. Anderson, London.
15,011. PRESSING HAY, &c., J. E. Sharman, London.
15,012. SOUNDING APPARATUS, F. R. Lucas, London.
15,013. SINAPISM, J. J., F. E., J., and R. J. Colman, London.

4th November, 1887.

15,014. SURGICAL SPLINTS, J. Mayer, London.
15,015. SEALING ENVELOPES, S. T. Brookes, London.
15,016. STAYS, W. Connell, Dublin.
15,017. OIL and SPIRIT LAMPS, J. H. Malin, Birmingham.
15,018. CHLORINE, G. E. Davis, Manchester.
15,019. MACHINE for BENDING PLATES, J. Rushforth, Hartlepool.

15,020. Cabinet and other Baths, D. J. F. Macleod Shrewsbury.
15,021. Cutting Machine for Garments, S. A. Cooke, Glasgow.
15,022. Dyeing Worsted Slivers of Fibres, J. Lodge, Huddersfield.
15,023. Type Writers, L. S. Crandall, Glasgow.
15,024. Serrating or Toothing Edges, C. Shaw, London.
15,025. Sifting Tea and other Substances, E. Burke, Dublin.
15,026. Saving Life in case of Fire, H. B. Manly, London.
15,027. Paper Files for Receiving Wires, A. Schapiro, Berlin.
15,028. Artificial Stone for Flooring, J. Lauder, Glasgow.
15,029. Ingot Moulds, J. G. Beckton, Middlesbrough-on-Tees.
15,030. Heating a "Copper," E. T. Barker and S. R. Swallow, Leeds.
15,031. Feeding-bottles, F. Hall and J. Titley, Bilston.
15,032. Boots, W. H. Stevens, Leicester.
15,033. Jointing Tubes, T. D. Shield and S. R. Lowcock, Birmingham.
15,034. Steering Gear Connections, C. F. Amos and H. W. R. Smith, Hull.
15,035. Screws for Operating Fallers, D. and H. Smith, Bradford.
15,036. Indicating the Depth of Liquid in Vessels, F. C. Clare, Stechford.
15,037. Grinding Plane Irons, &c., T. and R. Lees, Hollinwood.
15,038. Refrigerating Apparatus, E. H. Tompkins, Great Grimsby.
15,039. Stoppers for Bottles, C. E. H. Cheswright, London.
15,040. Utilisation of Water-power, J. Rettie, F. W. E. Gruggen, and H. J. Peachy, London.
15,041. Cutting Wire of Champagne Corks, W. Boyle, London.
15 042. Covering for Bottoms of Furnaces, J. Tibbs, London.
15,043. Breech-loading Fire-arms, A. Lindner, London.
15,044. Breech-loading Fire-arms, A. Lindner, London.
15,045. Tandem Safety, &c., Bicycles, W. Hillman, London.
15,046. Cushion for the Legs of Chairs, A. Darmer, London.
15,047. Presses, W. Kennedy, London.
15,048. Cutting Out Ladies' Garments, T. Wilde, London.
15,049. Extinguishing Fire, W. Mayall and T. Thomasson, London.
15,050. Locks, R. D. Jaques, London.
15,051. Automatically Discharging Hot-water, W. D. S. Moncrieff, London.
15,052. Heels of Boots, H. A. Oldershaw, London.
15,053. Pressing Cup-shaped Articles, W. R. Comings, London.
15,054. Lubricating Oils and Greases, M. J. Hartung and W. Gallagher, London.
15,055. Screw Propellers, A. Vogelsang, London.
15,056. Multiple Electric Cable, J. A. Betts, London.
15,057. Self-propelling Car, W. Durant and H. W. Hennes, London.
15,058. Starting Wheeled Vehicles, J. J. Hooker, H. Lescher, and R. G. Schwarz, London.
15,059. Emptying Painters' and Artists' Colour Capsules, A. E. Webb, London.
15,060. Rapid Shipment of Coals, S. W. Allen, London.
15,061. Machine for Wrapping Journals, G. M. Borns, London.
15,062. Controlling Pendent Roller Blinds, W. L. Turner, London.
15,063. Galvanic Batteries, D. Skrivanow, London.
15,064. Cooling and Refrigerating Machines, E. L. Pontifex, London.
15,065. Cement, F. Ransome, London.
15,066. Cooling and Refrigerating Apparatus, E. L. Pontifex, London.
15,067. Cleaning or Separating Tar from Ammoniacal Liquor, J. C. Kräyenbühl, H. C. Petersen, and C. C. Burmeister, London.
15,068. Tricycles, F. H. Gibbs, London.
15,069. Buckle Fastenings, A. Boccardo, London.—[Received 4th November, 1887. Antedated 14th September, A.D. 1887. Under International Convention.]

5th November, 1887.

15,070. Metallic Bedsteads, &c., F. Hoskins, Birmingham.
15,071. Chimney Top, J. Wright, Manchester.
15,072. Magazine Fire-arms, C. P. N. Weatherby, London.
15,073. Appliances for Flat Knitting Machines, C. Willson and G. Roberts, Grimsby.
15,074. Lock-up Frame for Bottles, P. R. Matthews, London.
15,075. Checking Moneys, G. H. Gledhill, Halifax.
15,076. Horse-collars, H. Frost and S. Salkeld, Manchester.
15,077. Life-boats, R. Chambers and W. Liddell, Glasgow.
15,078. Thermo-dynamic Engines, J. Hargreaves, Liverpool.
15,079. Inks, W. Hackney, Swansea.
15,080. Rotary Combing Machines, B. Berry, Bradford.
15,081. Railway Chair, J. Hanson, Sheffield.
15,082. Utilising Waste Heat, A. Denoon, R. Jameson, and A. Reid, Newcastle-on-Tyne.
15,083. Cleaning Knives, &c., M. A. Boyde and I. M. Lamb, Manchester.
15,084. Taking Up the Slack in Electric Wires, W. H. Sturge, Birmingham.
15,085. Hoes, &c., D. Smith, jun., Wolverhampton.
15,086. Pipe Mounts, C. Jackson, Nottingham
15,087. Embossing, &c., Metallic Strips, H. Theaker and J. Willis, Sheffield.
15,088. Wind-proof Cowl, R. E. Payne, London.
15,089. Distributing Fertilisers, W. P. Thompson.—(*G. W. Kirkpatrick, United States.*)
15,090. Lubricators, M. Falk, Liverpool.
15,091. Steam Tap, J. Eccles, Blackburn.
15.092. Cakes or Buns, A. Reid, Glasgow.
15,093. Tobacco Pipes, T. W. L. Stansfeld, London.
15,094. Pumps, H. M. Thomas, London.
15,095. Electro-dynamic Apparatus, S. Evershed and W. T. Goolden, London.
15,096. Fire-places of Kilns or Ovens, S. Fenn and A. Fenn, Birmingham.
15,097. Fulling, &c., Yarns, W. A. L. Hammersley, London.
15,098. Pipes, G. H. and A. L. Lloyd and H. Bewlay, London.
15,099. Transmitting and Receiving Apparatus of Type-writing Telegraphs, A. Le N. Foster and W. S. Steljes, London.
15,100. Splitting Wood, W. H. Munns.—(*D. E. Blacke, New South Wales.*)
15,101. Velocipedes, G. Singer, London.
15,102. Velocipedes, T. W. Boothroyd and P. L. C. F. Renouf, London.
15,103. Circular Boxes with Removable Lids, W. White, London.
15,104. Castors for Furniture, K. R. McD. Wilson.—(*A. Rix, California.*)
15,105. Bottling Aerated Waters, E. Rowlands, London.
15,106. Fire-engine, R. Morrell, London.
15,107. Argand Burner, W. W. Horn.—(*S. J. Dodd, United States.*)
15,108. Automatic Fan for Rocking Chairs, E. Edwards.—(*A. Hertz, Germany.*)
15,109. Pickling the Surface of Iron, A. Gutensohn, London.
15,110. Buttons for Garments, A. C. Hempel, London,
15,111. Pipes for Smoking, D. Grünfeld and W. B. Haas, London.
15,112. Cases for Pillows, M. Barker, London.
15,113. Fire Alarm, W. A. Nippoldt, London.
15,114. Pile Drivers, G. Sonnenthal.—(*E. Sonnenthal, Berlin.*)
15,115. Lever Presses, W. J. and C. T. Burgess, London.
15,116. Wheels of Vehicles for Advertising, E. O. Eaton, London.
15,117. Electric Motor, J. M. V. Money-Kent and S. Sharp, London.
15,118. Incandescent Lamps, W. Clarke and C. A. Parsons, London.
15,119. Signalling on Railways, &c., A. Duffin, London.

7th November, 1887.

15,120. Rollers for Cotton Spinning, &c., G. Batten, Bolton.
15,121. Pans, T. Bowler, Keighley.
15,122. Weaving the Borders of Towels, F. Morrison and E. Beveridge, Dunfermline.
15,123. Displaying Figures on Glass, G. A. J. Schott, Bradford.
15,124. Elevators, W. Goodwin, Liverpool.
15,125. Receptacles for Inks, &c., H. J. Harman, London.
15,126. Staiths, G. Taylor, Penarth.
15,127. Stoppering, &c., Bottles, H. Cochran, Dublin.
15,128. Oil Lamps, J. D. Dobson, Bradford.
15,129. Railway Signalling, E. C. Warburton, Manchester.
15,130. Useful Combination Stands, A. McCleverty, London.
15,131. Preventing Rolled Iron from Buckling, &c., F. Pilkington, London.
15,132. Feed Water Heaters, J. Smith, Glasgow.
15,133. Road Net, H. G. Powell, London.
15,134. Presses for Extracting Oil from Linseed, F., H., and A. Workman, London.
15,135. Elastic Metal Casings, H. C. Carver, London.
15,136. Electric Torch for Lighting Fires, &c., S. S. Bromhead, London.
15,137. Staiths for Shipment of Coals, S. Butler, London.
15,138. Heating Water Pipes, &c., H. J. Allison.—(*W. M. Brown and S. W. Whitmore, United States.*)
15,139. Artificial Legs, C. A. Frees, London.
15,140. Rotary Expansive Steam Engine, &c., W. T. Sturgess and E. Towlson, Norwich.
15,141. Galvanic Batteries, A. F. St. George and C. R. Bonne, London.
15,142. Carriers for Optical Lanterns, W. H. Humphries, London.
15,143. Secure Letter-box from Robbery, E. Bassett, London.
15,144. Sewing Machines, E. Frankenburg, London.
15,145. Unfastening Doors of Theatres, G. Denys, London.
15,146 Removing Snow from Roads, J. G. L. Bryan and J. S. Hough, London.
15,147. Lubricating Railway Axles, &c., T. F. N. Finch, London.
15,148. Bolts for Shop Window Shutter Bars, J. Cardwell and J. Chandler, London.
15,149. Prop for Hansom Cabs, H. English, London.
15,150. Ploughs, A. C. Henderson.—(*P. Feat, France.*)
15,151. Folding Cots or Bedsteads, F. Parker, London.
15,152. Construction of Portable Fountain, J. O. Spong, London.
15,153. Adjusting the Front Slides of Photographic Cameras, R. Overton, London.
15,154. Producing Yellow, &c., Covering from Tetrazo-diphenyle and Tetrazo-ditolyle, C. D. Abel.—(*G. C. Zimmer, Germany.*)
15,155. Water Pressure Engines, J. T. Short and C. C. Lewis, London.
15,156. Washing, J. Gamgee, London.
15,157. Tipping Wagons, D. Greig, R. H. Shaw, and H. C. Duburguet, London.
15,158. Electric Safety Lamps, J. Sinclair and J. P. Rees, London.
15,159. Groove and Tongue Cutting Machine, J. Lee, London.
15,160. Bearings for Velocipedes, W. Bown and J. H. Hughes, London.
15,161. Coin-freed Electrical Apparatus, P. Everitt, London.
15,162. Postage Wrappers for Samples, L. P. Leclercq, London.
15,163. Leather Scarfing Machines, H. Brehmer, London.
15,164. Production of Cyanogen Compounds from Gas, O. Knublauch, London.
15,165. Chronometers, F. D. Dencker, London.
15,166. Cutting Wood into Chips, &c., O. A. Winter, London.
15,167. Stoves for Heating Apartments, W. Jackson, London.
15,168 Separation of Zinc Hydrate as a Crystalline Body, H. Senier, London.

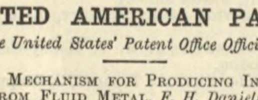
SELECTED AMERICAN PATENTS.

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

368,817. Mechanism for Producing Ingots, Bars, &c., from Fluid Metal, *F. H. Daniels, Worcester, Mass.—Filed April 27th*, 1887.

Claim.—(1) In a mechanism for forming ingots or bars from fluid metal by a continuous process, the combination of the revoluble carrier wheel and a series of removable segmental mould sections, the ends of which abut and match against each other, said sections together forming a complete circular matrix and adapted for interchanging for different sizes of matrix and for renewal in case of wear, substantially as set forth. (2) The mould section C, for ingot forming mills, formed as a circular segment having the matrix groove C^1 along its upper side and a cavity or water space *c*, formed therein along its under side, substantially as set forth. (3) The combination, with a supporting carrier, of removable mould sections composing the continuous matrix and having a water space formed therein, substantially as and for the purpose

368,817

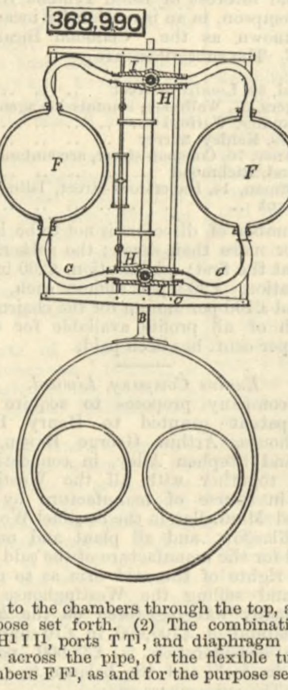


set forth. (4) The combination, with the revoluble carrier wheel A, having the seating surface *a*, of the continuous annular mould composed of a series of segmental sections C, and attaching devices adapted for confining the mould sections upon the carrier wheel and for separately adjusting said sections to proper alignment with each other, in the manner substantially as hereinbefore set forth. (5) The combination, with the revoluble carrier wheel A, having the seating surface *a*, of the upwardly bevelled segmental mould sections supported thereon, the fastening studs E, having an outwardly inclined side, and the fastening studs D, having an inwardly inclined side, fitted in the rim of the carrier wheel, and said studs oppositely embracing the bevelled sides of said mould sections, and means for adjusting or drawing down said studs within the rim to a greater or less extent, substantially as and for the purpose set forth. (6) In mechanism for forming ingots, bars, or rods from fluid metal, the combination of the detachable mould sections having a water space or cavity, as set forth, and the mould supporting carrier provided with passages disposed to deliver the water through the body of the carrier into said cavity of the mould, substantially as and for the purpose set forth.

368,990. Water-feeder for Boilers, *J. Austin, near East Liberty, Ohio.—Filed April 20th*, 1886.

Claim.—In a boiler feeder, the combination, with standard B and pivotted frame C, of the chambers F F^1, pipes H H^1 I I^1, ports T T^1, and the diaphragms S, placed obliquely across the pipes and so arranged that the water shall be admitted to and emptied from the chambers at the bottom, while steam is alternately

368,990

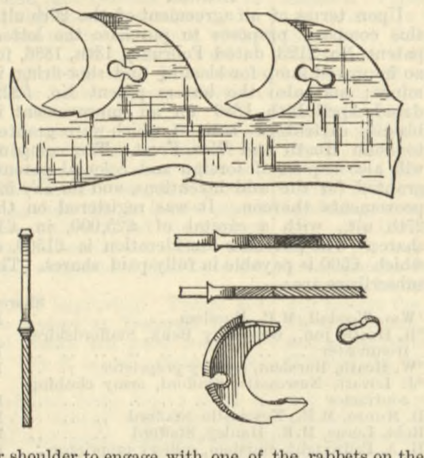


admitted to the chambers through the top, as and for the purpose set forth. (2) The combination, with pipes H H^1 I I^1, ports T T^1, and diaphragm S, placed obliquely across the pipe, of the flexible tubes G G^1 and chambers F F^1, as and for the purpose set forth.

368 999. Reversible Saw-tooth, *J. E. Emerson, Beaver Falls, Pa.—Filed May 4th*, 1887.

Claim.—(1) A reversible saw tooth having a circular body provided with an aperture near its centre and cutting portions or teeth of different thicknesses at its ends, both of the teeth being thicker than the body portion, substantially as described. (2) A reversible saw tooth having a circular body and cutting portion or teeth at its ends, in combination with a saw plate having circular recesses to receive said tooth, a detachable yoke, and clearance spaces at the ends of the yoke, substantially as and for the purpose set forth. (3) A reversible saw tooth having a circular body, cutting portions or teeth at its ends, and rabbets adjacent to the teeth, in combination with a saw plate having circular recesses and provided with a projection

368,999

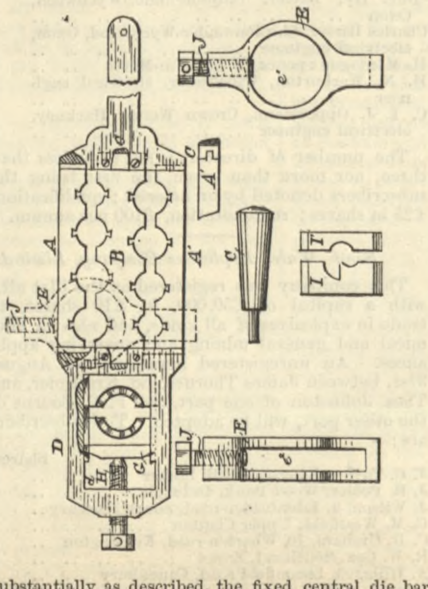


or shoulder to engage with one of the rabbets on the tooth, a detachable yoke, and clearance spaces at the ends of the yoke, substantially as described. (4) Reversible saw teeth having a circular body, cutting portions or teeth at their ends, a cylindrical aperture and a slot, in combination with a saw plate having circular recesses and cylindrical recesses and slots, and yokes conforming to the apertures and slots in the teeth and the saw plates, the cylindrical portions of the yokes being slightly smaller than said apertures and affording clearance space at the ends of the yokes, substantially as described.

369,002. Screw Plate, *N. Harris, Vincennes, Ind.—Filed November 30th*, 1886.

Claim.—(1) In a device to cut screw threads, the combination of the end parts or pieces C D, constructed

369,002

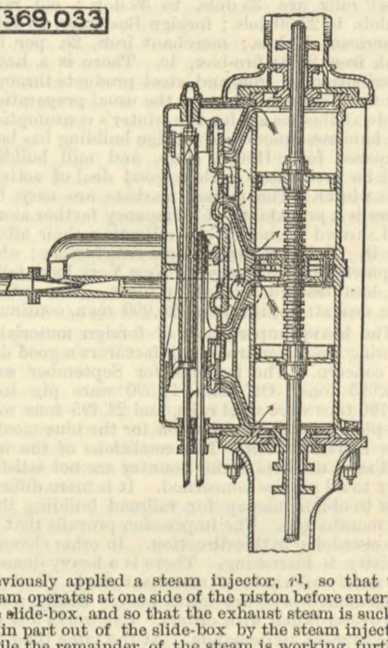


substantially as described, the fixed central die bar having die notches on each edge, and the adjustable die bars on each side of the same, provided with the die notches on their inner edges, registering with similar die notches in the adjacent edges of the fixed die bar, substantially as specified. (2) In a device to cut screw threads, the combination of the end parts or pieces C and D, the fixed central longitudinal die bar B, connecting said end pieces, the adjustable die bars A A^1, having their ends rabbetted or tenoned to move in grooves on the inner edges of said end pieces, the brace or clamp frame E, having the opening e^1 and slot e^2, and the set screw J, to hold said brace frame on the die bars A A^1, substantially as specified. (3) The combination, with the end pieces C D, and die bars A A^1, and B, all constructed substantially as described, of the cutting blocks F F^1, provided with rabbetted or tenoned ends to move in corresponding grooves in the longitudinal bars of the opening *d* of the piece D, the block or bar G, and the set screw H, passing through a threaded opening in the end bar of the opening *d* and impinging upon the block or bar G, substantially as specified. (4) The combination, with the end pieces C D and die bars A A^1 B, all constructed substantially as described, of the cutting tools I I^1, having their ends rabbetted or tenoned to move in corresponding grooves in the piece D, the block or bar G, and the set screw H, substantially as specified.

369,033. Steam Engine, *W. Schmidt, Brunswick, Germany.—Filed January 12th*, 1887.

Claim.—The method of utilising exhaust steam by conducting the steam under the slide valve after having

369,033

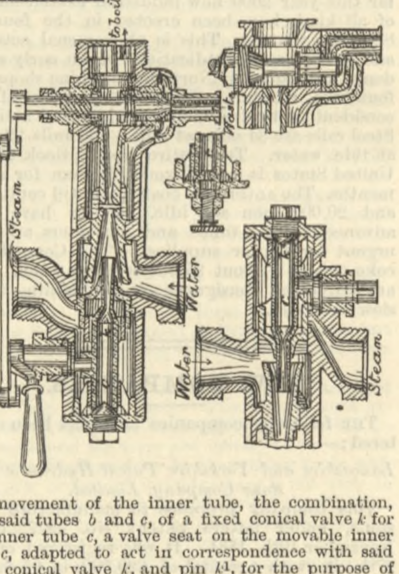


previously applied a steam injector, r^1, so that the steam operates at one side of the piston before entering the slide-box, and so that the exhaust steam is sucked up in part out of the slide-box by the steam injector, while the remainder of the steam is working further by expansion on a steam piston, substantially as described.

369,097. Injector, *F. Brunbauer, Vienna.—Filed March 29th*, 1887.

Claim.—(1) In an injector with two concentric steam tubes, the inner one of these two tubes being endwise movable, forming between them a steamway of ring-shaped section, and adapted to operate a fixed cut-off valve by the movement of the inner tube, the combination, with said tubes, of a fixed conical valve for the inner tube, a valve seat on the movable inner tube adapted to act in correspondence with said fixed conical valve, and means for the adjustment of the tube, substantially as and for the purpose set forth. (2) In an injector with two concentric steam tubes, the inner one of these tubes being endwise movable, forming between them a steamway of ring-shaped section, and adapted to operate a fixed cut-off valve by

369,097

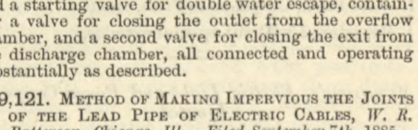


the movement of the inner tube, the combination, with said tubes *b* and *c*, of a fixed conical valve *k* for the inner tube *c*, a valve seat on the movable inner tube *c*, adapted to act in correspondence with said fixed conical valve *k*, and pin k^1, for the purpose of shifting the tube *c* by steam pressure, substantially as described. (3) In an injector with two concentric steam tubes, the inner one of these tubes being endwise movable, forming between them a steamway of ring-shaped section, and adapted to operate a fixed cut-off valve by the movement of the inner tube, the combination, with said tubes, of a fixed conical valve for the inner tube, a valve seat on the movable inner tube adapted to act in correspondence with said fixed conical valve, means for the adjustment of the tube, and a starting valve for double water escape, containing a valve for closing the outlet from the overflow chamber, and a second valve for closing the exit from the discharge chamber, all connected and operating substantially as described.

369,121. Method of Making Impervious the Joints of the Lead Pipe of Electric Cables, *W. R. Patterson, Chicago, Ill.—Filed September 7th*, 1885.

Claim.—The method of making tight and impervious the joints of the lead pipe of a telegraph cable, which

369,121



consists in applying a compound to the outside of the joint and exhausting the air within the pipe, and thereby drawing the compound into the openings in the joint, whereby the openings are filled, substantially as and for the purpose specified.