THE TRIANGULATION AND MEASUREMENT OF THE FORTH BRIDGE.

By Reginald E. Middleton, M.I.C.E.

No. I.

The writer proposes in the following paper to give a description of the setting out of the Forth Bridge, the tools and instruments used, and the amount of accuracy obtained, along with some remarks on the instrumental and personal errors.

General description of site.—It is necessary, in order to be able to understand what follows, that a short description of the site of the bridge be given, which will be further illustrated by the accompanying diagrams, Nos. 1 and 2. Diagram No. 1 is a plan showing the centre line of the bridge by a line A C, and the system of triangulation in lines A O, C P, &c. Diagram No. 2 is a section through the centre line of the bridge showing the different stations on line A C. The total length of the bridge between centres of abutments is 8080·5ft., and the level at these points is about 110ft. above Ordnance datum, the ground falling very rapidly in each case to a level of about 15ft. above Ordnance datum. The distance from the south abutment to high-water mark is about 560ft., and from the north abutment 1785ft., the distance which is inaccessible at high-water being approximately 5735ft., or one mile and one-twelfth nearly. At low water this distance is about 120 yards less. At high water the Island of Inch Garvie, at the centre line of the bridge, is covered, but a small brick pier had been built by the contractors for the old Forth Bridge, which is 54·71ft. north of the centre line of the northern Inch Garvie piers, which gives an accessible point there at all times of tide. This point, called B, is 4024ft. from the south shore and 1711ft. from the north shore, or thereabouts.

Base line to be measured.—When the writer went to South Queensferry in the early part of January, 1883, it was desired to make an immediate start with the foundations of the piers on both sides of the Firth, and to this end it was necessary to fix, at the earliest possible moment, the distance of two points, one on the north and one on the south side, and their relative distance from the point B on the Island of Inch Garvie. To effect this purpose a base line must be measured of suitable length and a careful triangulation made. The writer therefore ordered the materials for making three standard rods 12ft. long, and he inspected the borders of the Firth of Forth on both sides, in order to decide on the direction and approximate length of the base line to be measured and the position of the observatory from which the main triangulation should be made.

Position of base line and observatory.—The writer soon found that there was only one satisfactory course for the base line to take, namely, from a point called I in the centre line of the bridge, near the face of the south abutments down the centre of a siding laid by the North British Railway Company from South Queensferry station to the Forth Bridge works, which is straight for about 2000ft., when the line begins to curve to the right; along the platform of South Queensferry station, across the line, up the side of the cutting diagonally, over a bridge over the line, down a short lane, through a fowl pen, and then across a steadily rising open country for about 1500ft., and finally falling slightly for the last 500ft.; the end of the base line thus laid out being called P. The two ends of the base line were, unfortunately, not visible from each other at the ground level, therefore high poles had to be used for sighting; and though every care was taken to place and keep the poles vertical, some slight error may have crept in, and it would have been better to have constructed a timber or masonry stage at P, whence the bottom of the pole at I could have been seen. The approximate length of the base line was 4000ft. The author also decided that, within a few feet, there was only one place suitable for an observatory, namely, near the outer end of a rough stone jetty, run out by the North British Railway Company for about 1300ft. into the Firth to protect the harbour of Port Edgar.

Ordnance survey.—In the meantime Mr.—now Sir John Fowler—the engineer-in-chief, desiring to have a check on the general measurements across the Firth, arranged with the Ordnance Survey Department that they should send down a qualified man to take up some of the points in the main triangulation, and insert in the measurements three stations in the centre line of the bridge, one being on the south side, one being on the north, and one on Inch Garvie Island at B. Accordingly a sergeant of Engineers came down, bringing with him a 12in. transit and a 7in. Everest's theodolite; he picked up the old stations, and inserted the new ones A on the south side, B on the island, and C on the north side, and at the writer's suggestion also included the position marked out for the observatory at O. The distances thus measured were given by the Ordnance Department, as being :—A C, 7607·37ft. ; A B, 5401·45ft. ; B C, 2205·92ft. The sergeant of Engineers also gave the distance A I, as measured with standard chain, as being 846·75ft., and C D—D being a point near the Fife piers—as 501ft.

Commencement of setting out piers on north side.—It being desired to commence operations on the north side, the above measurement from C to D was taken as correct, and the centre for the northern Fife piers set out from it; this distance, when measured with standard rods, was found to be 0·79ft. too short, the true dimension being 501·79ft., and this caused the whole structure to be set out 0·79ft. south of the setting as originally proposed.

Standard rods.—The rods when delivered had to be corrected to a standard length, but for this purpose no adequate preparation had been made, and the writer was obliged, for want of better appliances, to content himself with a female gauge made of iron tipped with steel, fitted at the time of measurement to two 6ft. boxwood rods supposed to be standard, and checking the same by means of steel tapes and boxwood scales. The boxwood rods being laid on the bed of a planing machine, the female gauge was made to fit them, and immediately transferred to the rods to be made standard, which were adjusted to it by means of hard wood wedges provided in one end of each rod for this purpose. Each rod was treated in this manner, and the whole were then checked with the steel tapes and a length set out with 12in. scales on the machine bed and the whole averaged, the gauge was again adjusted to these rods and put by for future reference. Any error such as would be likely to exist in these standards would not have been of the least importance, as both the foundations and steel work would have been set out from the same standards, if it had not been that the main points of reference were set out from the Ordnance Survey, necessitating that survey being taken as the standard of length for the whole. What the differences were, and how they affected the structure, will appear as the work progresses.

Fig. 1

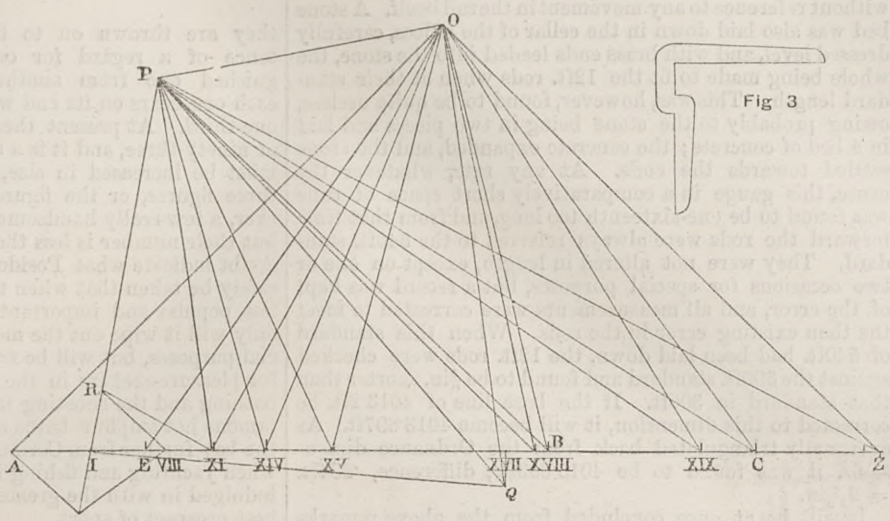
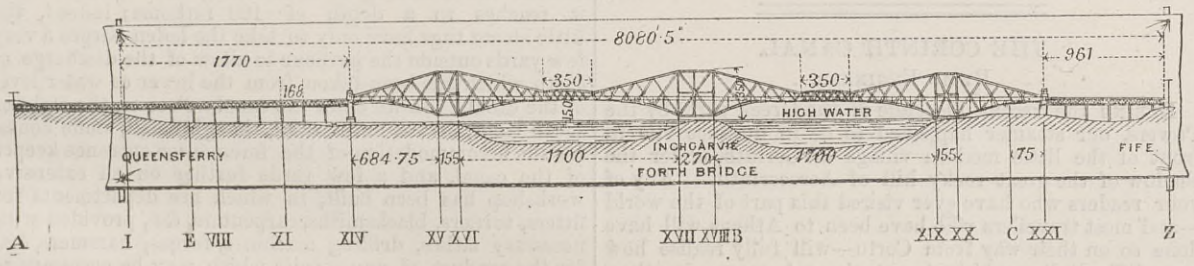


Fig. 2



Measurement of base line.—The measurement of the base line commenced about February 25th. At first the rods were supported on blocks of wood, each rod being approximately levelled transversely, and then brought to a level longitudinally by means of packings of wood laid under it, the level used being an ordinary mason's level. This arrangement was found to be both tedious and liable to accidents and error, owing to the difficulty in bedding the blocks firmly, and to the inexperience and carelessness of the men assisting, and though frequent bench marks were plumbed down and secured, a good deal of the work had to be done over again. Wooden trestles, with two cross-bars each and of varying lengths, were therefore made and driven into the ground, and the rods rested on them, two trestles to each rod. The line from the works to South Queensferry Station is straight, but falls with an even gradient of 1 in 70 towards Queensferry, and this gradient, if followed regularly, is just enough to prevent the rods facing. It was therefore necessary to lay a length of three or four rods level, and then make a drop, which, in order to introduce a plumb bob or the square, which was frequently used for bringing the faces of the rods into a vertical plane, and which will be described with the other tools, could not be less than 5in. The rate of progress was at the commencement about 24ft. an hour. The highest rate attained was about 86ft. per hour, and the average about half the last amount. At the end of each period of measurement a strong peg was well driven into the ground, and a nail put into the head of it where the measurement ended. The distance from the last peg and nail was taped, and that distance added to former measurements and recorded. The total length of the base line I.P. as measured by the rods was 4013·2ft. While the above measurement was being made a staging was in course of erection at O, sufficiently large to support an observatory, and a platform two planks wide was laid from the main land along the jetty to the site of the observatory; and when the main base line was completed the writer proceeded to make a rough measurement from the termination of the former at P to the site of the observatory at O. This line P O was much more difficult than the former, the fall being rapid, and it being necessary to cross the Queensferry branch of the North British Railway on a slight skew, where it is in some 20ft. of cutting; to cross a gulley on a considerable skew; to get down a steep bank, and to cross a quarry hole full of water, and about 120ft. wide. As this measurement was only required as a check, the same amount of accuracy was not attempted as in the main base line, only the portions of ground which were easily measurable with the standard rods being set out with them; the rest of the distance, about 900ft., was measured with a steel sounding wire.

Measurement with wire.—In order to use the wire, a distance of 300ft. was accurately measured with the rods on the stage leading to the observatory. The wire was laid on this, a mark having been previously made near one end by means of a piece of copper wire twisted round the steel and soldered on; it was pulled straight and a similar mark was made at the other end. The wire was then transferred to the place to be measured, stretched from the last fixed point, set straight with the theodolite, and held in place by its being lashed to two of the trestles already mentioned as being used to support the rods, these trestles being again lashed to other shorter trestles placed behind them. The accuracy of the starting point was tested by the plumb bob, and corrected by tightening or loosening the lashings of the trestle nearest P. The difference of level between the ends and the centre was taken with a spirit level, and the distance was marked down, calculated, and booked. The wire was then tested for length on the standard laid down on the stage, and the error, which was a gradually increasing one, and eventually amounted to 9in., was also booked.

Error in line P O.—The results of the whole measurement between P and O, amounting in distance to about 3000ft., could only be looked on as an approximation. It was, however, eventually found to be correct within about 2in.

Triangulation.—The next step to be taken was to ascertain the value of the angles to be measured, and for this purpose a 7in. theodolite, constructed by Messrs. Negretti and Zambra, had been procured, and the writer proceeded to take the several angles at I, the commencement of the base line, at P its termination, at O the observatory and termination of the second base line, at B the fixed point on Inch Garvie Island, and at C a pole put in by the Ordnance Survey Department in the centre line of the bridge, on the north side of the Firth, and so calculate the lengths I B, I C, from the base line I P. In order, however, to compare the measurements so arrived at with those made by the Ordnance Survey Department between A B, A C, it was necessary to have the distance A I accurately measured, and when this was done it was found that A I was 846·77 as against 846·75, as given by the chaining of the Ordnance Survey Department. Deducting this length from A C, the distance I C should have been, in order to agree with the Ordnance Survey, 6760·62. It was, however, found to be by triangulation from base line I P 6759·46, or 1·16 shorter. If reduced to the same terms, the proper length of base line would be 4013·89, but also the length A I would be 846·91, not 846·77, and I C will be 6760·48, and the base line 4013·80. It is, however, proved elsewhere by comparison with 10ft. rods, that the length of this base line was 4013·897, the final length arrived at by triangulation from Ordnance Survey being 4013·693. The error in measurement, or rather the difference between this standard and that arrived at from the Ordnance Survey, in which a possible error of 3in. is allowed for in 7609ft., is 0·204ft. or $2\frac{7}{16}$in. in 4013ft., or ·386 = $4\frac{5}{8}$in. in 7607ft., or ·086 = $1\frac{1}{32}$in. in 1700ft., the 10ft. standard rods being shorter to this extent than Ordnance measurement. It was, as has been before stated, necessary to accept the distance given by the Ordnance Survey as correct, and this triangulation and subsequent measurements proved conclusively that the difference was not appreciably greater than the above, namely, 0·21ft. in 4000ft.

Setting out piers on north side.—The piers on the north side were set out by direct measurements with the standard rods, making C the fixed starting point in each direction. At each pier four stones were set in concrete and marked for future reference. Bench marks were also cut in the rock where convenient, and permanent theodolite stations built at the centres of the Fife Piers, stations XIX. and XX.

Setting out piers on south side.—On the south side a similar course was pursued, starting at I; the difficulties, however, were much greater, owing to the rapid slope of the ground, approximately 1 in 2, which made it impossible to measure lengths of 12ft., and exceedingly difficult to keep the rods steady. The measurement of the first 436ft. was therefore repeated three times, but in the meantime No. 1 pier, station IV., had to be commenced with such information as was then obtained. As none of the measurements I E agreed absolutely, a station was fixed at the bottom of the slope by triangulation from a short base line, and the further measurement carried on from this point; this proved the setting of pier No. 1 to be 2in. out. At 436·14, according to this measurement, a brick pier was erected to serve as a theodolite station and a standard bench mark for levels; also at this point, which was close to high-water mark, it was necessary to transfer the survey line from the centre line of the bridge to a line parallel to the centre line, so that it might pass along the stage erected alongside the piers. A point was therefore squared off and marked down on a stone, and in order to maintain a parallel line, sighting poles were placed in conspicuous positions in this line on the north and south sides, and at the same time poles were fixed accurately in masonry piers 60ft. on either side of the centre line of the bridge on both sides of the Forth to maintain the centre lines of the caisson piers. All these poles were set out with the standard rods, and wherever poles were placed they were fixed in a substantial manner in stone, brick, or timber piers from 6ft. to 8ft. square, and a railing was run round each, to which the pole was in many cases stayed on top, and on which a canvas screen could be stretched to protect the instrument in stormy weather.

Setting out piers from E to XIV.—Having now a point in a line parallel to the centre line of the bridge at 436·14ft. from I, and poles on both sides of the Firth to maintain the parallel line throughout, the measurement was proceeded with up to the centre of No. 5 pier, or to 839·14ft. in the measurement, and was subsequently carried on to the centre of the south cantilever pier, station XIV.

Wire measurements between stations XVIII. and XIX.—A theodolite station having been erected on Inch Garvie Island, in the centre line of the two northern caisson piers, station XVIII., at 54·71ft. south of station B, Mr. Baker was desirous to check the distance from the similar station XIX. at the southern Fife pier by an independent measurement, and this he proposed to do by means of a sounding wire of steel about $\frac{1}{20}$in. diameter and weighing about 9 lb. for a length of 1800ft. It thus became the author's duty to make this measurement in conjunction with Mr. P. W. Meik, M.I.C.E., the resident engineer, who represented Sir John Fowler and Mr. Baker at the Forth Bridge.

Measuring wire on North British Railway.—A suitable site for the measurement of the wire was found alongside the railway between the Forth Bridge Works and Dalmeny station. The distance, viz., 1700ft., was first measured as already described, and was subsequently checked by squaring off at both ends and running the rods along a rail in the line and calculating the error due to gradient, and the difference between the two measurements was $\frac{1}{8}$in.

Marks on wire, means of fixing.—The distance between the two posts carrying wooden clips in which the wire was to rest having been measured from face to face of clips, a point half way between the two stations was marked and a platform laid down 25ft. below the level of the clips, a mark having been made on the wire by means of a copper wire twisted and soldered on, and a further mark being provided 6in. from the last by means of a brass clip; the point thus marked was brought to the face of the northern clips and fixed there, the wire was paid out and carried through the southern clips, and then tightened until the centre was 1ft. above the central platform, thus giving a versed sine of 24ft. The centre and north end were then marked by wire twisted on and soldered, and by a clip 6in. off, as in the case of the northern end; the wire was then coiled on its drum and was ready for use.

Preparations for wire measurements in situ.—To use the wire similar posts were built into stations XVIII. and XIX., and clips were fixed on them in the positions fixed for the centres of the piers. A theodolite station was fixed in such a position on the island that the axis of the instrument should be 24ft. below the centres of the clips, and on the north side a marked board was fixed at the same level, so that it was only necessary to sight on the board, and the line thus obtained would give the proper deflection for the wire. It is true that there is a slight error for curvature, but it is so small that it may be ignored. On a perfectly calm day arrangements were made for preventing any shipping passing through the northern channel; the wire was fixed in the clips at station XIX., and was hauled across to the island, where it was brought up to the clips, so that the mark on the wire touched the face of the clips; it was, however, found necessary to draw in the wire 18in. before the proper deflection of 24ft. was obtained. The span then appeared to be 18in. too short.

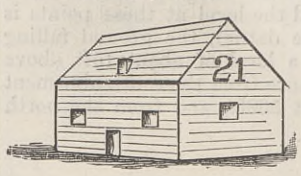
Result of wire measurement unsatisfactory.—This result was eminently unsatisfactory, but before it could be accepted it was necessary to refer the wire to its place on the railway, where, however, it fitted exactly. It was therefore necessary to look for the error elsewhere, and the writer proceeded at once to test the rods on the 300ft. standard laid down on the stage leading to the observatory, when he found that the rods were ·173ft. longer in 300ft. than they were when this standard was laid down; ·173ft. in 300ft. is ·9067 in 1700ft., or $10\frac{7}{8}$in., leaving $7\frac{1}{8}$in. still to be accounted for. It may here be stated that the writer can in no way account for the whole of this enormous error in the rods at this particular time, for it was abundantly proved by later measurements that up to that time, with the exception of one measurement between stations XIX. and XX., the maximum divergence from the original setting had not exceeded ·024ft. in 300ft. At the time of the wire measurement, that is, in the end of October, 1883, the rods were checked from the iron gauge, and a small error may be accounted for by difference of temperature; but as the average temperature in February, when the gauge was made, is 42 deg., and in October 49 deg., this will only account for an error of about ·014ft. in 300ft., or ·078ft. in 1700ft. The writer can therefore only suppose that the gauge had suffered some injury just at that time. The average error due to temperature would be from 43 deg. to 60 deg., or 17 deg., which would give ·0335ft. in 300ft., or ·19ft. in 1700ft.; and it will be seen from the records of the rod tests that they do not increase in length with increased temperature to anything like this extent—indeed their tendency is to become shorter during the summer months. Also as the increase in length of the iron gauge due to temperature was known and its effects on the setting out had already been called attention to, this tendency was counteracted, as far as possible, first by keeping the gauge in the most even temperature poscurable, and next by allowance in the setting of the rods. Of the 18in. difference between the wire and the distance set out for a span of 1700ft. between stations XVIII. and XIX., $10\frac{7}{8}$in. has been accounted for, leaving $7\frac{1}{8}$in. unaccounted for. It has already been shown that to agree with Ordnance measurement, the base line measured as 4013·2 ought to be 4013·80. If this be true, then the rods when the 300ft. base line was set out were ·0523ft. too long in 300ft., and this will account for ·2965ft. in 1700, which, added to ·9067 = 1·2032ft., leaving ·2968ft. still to be accounted for; but if the rods were long when the 300ft. standard was set out, the distance C-XIX. must also be long to the extent of ·0838ft., also the distance XIX.-XX. was found to have been set out with the rods as used for the measurement of the wire; therefore this distance was ·0896ft. too long, therefore the distance XVIII.-XIX. was not 1700ft. but 1699·8266ft., and the error in the wire was not 1·5ft. but 1·3266ft.; or, to reverse the calculation, the corrections on the error of 1·5ft. are:—·9067 + ·2965 + ·0838ft. + ·0896ft. = 1·3766, leaving error still unaccounted for ·1234 = $1\frac{15}{32}$in. These are the calculated results. As a fact, the distance XIX.-C was proved to be somewhat longer than stated here—see table in appendix. As a further check on this calculation the marks on the poles on the railway were set back 1·3203, and the distance was again measured with the corrected rods and found to be 1700·0078, therefore the set-back should have been 1·3281 as against 1·342 by former calculation, difference ·014 or $\frac{5}{32}$in. In order to verify the results thus obtained, Sir John Fowler determined to procure three rods which should be standard, and when these arrived a length of 540ft. was measured along a rail on the railway, and marks were cut in the rock on both sides of the line, at each end of the standard, so that a string or wire being stretched from mark to mark the termini of the standard could be transferred on to the rail at all times, without reference to any movement in the rail itself. A stone bed was also laid down in the cellar of the offices, carefully dressed level, and with brass ends leaded into the stone, the whole being made to fit the 12ft. rods when at their standard length. This was, however, found to be quite useless, owing probably to the stone being in two pieces and laid in a bed of concrete; the concrete expanded, and the stone settled towards the ends. At any rate, whatever the cause, this gauge in a comparatively short space of time was found to be one-sixteenth too long, and from that time forward the rods were always referred to the 540ft. standard. They were not altered in length, except on one or two occasions for special purposes, but a record was kept of the error, and all measurements were corrected to meet the then existing error in the rods. When this standard of 540ft. had been laid down, the 12ft. rods were checked against the 300ft. standard and found to be $\frac{5}{8}$in. shorter than that standard in 300ft. If the base line of 4013·2ft. be corrected to this dimension, it will become 4013·897ft. As eventually triangulated back from the Ordnance dimensions, it was found to be 4013·693ft.; difference, ·204ft. = $2\frac{7}{16}$in.

It will be at once concluded from the above remarks that as the rods were too long in the first instance, and therefore station I. was set out ·16ft. too far north and station XIX. ·159ft. too far south, and as on the south side the foundations of the piers had been set up to pier No. 5, station IX., some readjustment was necessary. The error to be corrected was found to be ·24ft. between stations IX. and XXI.—a length of 5349·50ft. This error was, for the sake of uniformity, divided up between stations XIV. and XXI. No actual alteration was required in any pier, but the position of the station was moved to suit the dimensions, which will be found in the tables. At the same time as the 10ft. standard rods were procured by Mr. Fowler, a 12in. transit theodolite was ordered from Messrs. Cooke and Sons, of York, and this instrument was used in the further triangulation.

THE CORINTH CANAL.

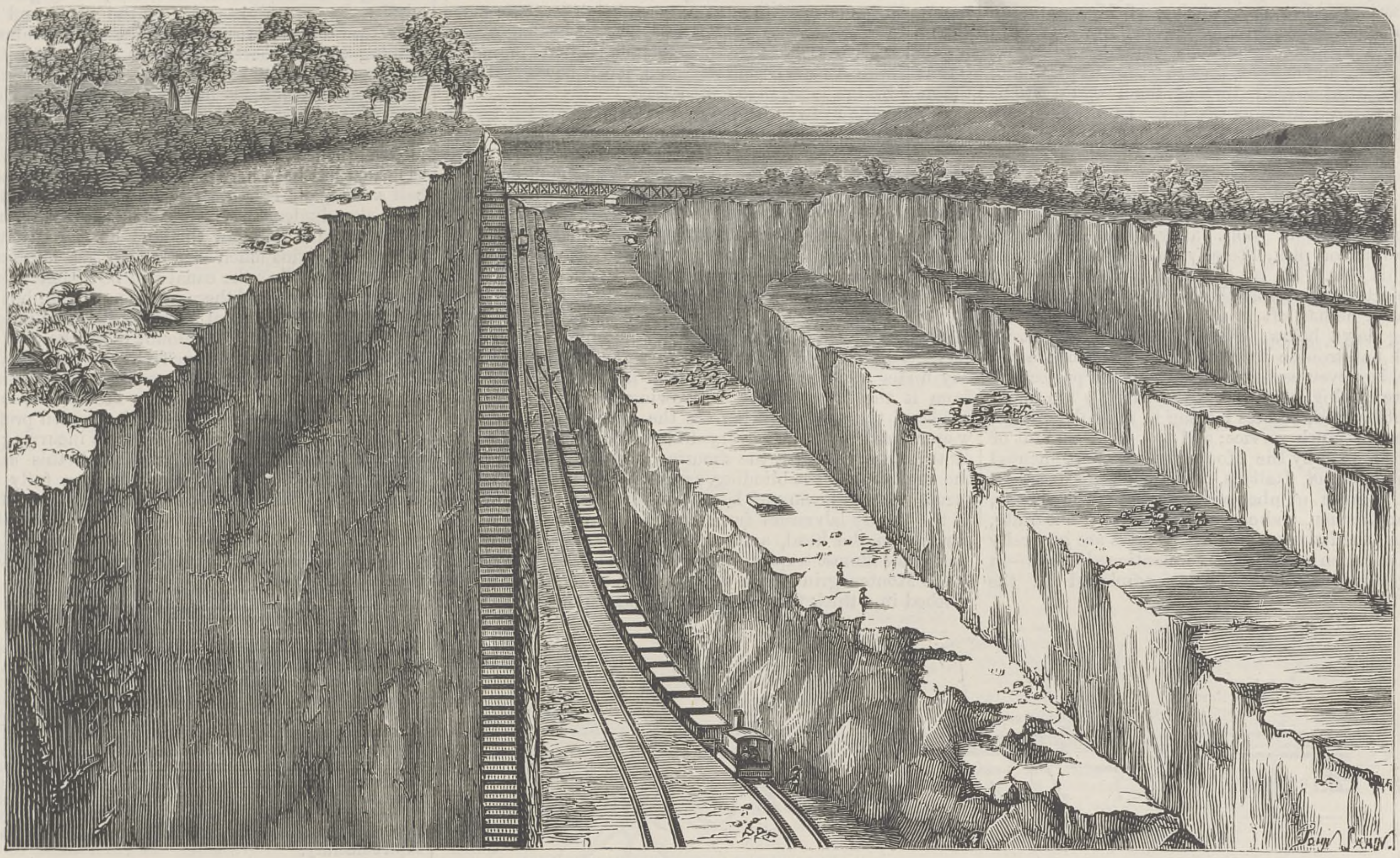
By an Engineer.

During the recent blockade of the Greek ports by the Powers, our steamer happened to be in durance vile in front of the little modern village of Corinth, under the shadow of the great rocky hill of Acrocorinth. Any of your readers who have ever visited this part of the world —and most travellers who have been to Athens will have done so on their way from Corfu—will fully realise how very difficult it would be to get through even a few days at so sleepy, so slow, and at this time of the year so hot a place, and they will be able to sympathise with one who has been condemned by the exigencies of the times—which required the combined fleets of England, Austria, Germany, Italy, and Russia, to coerce poor little Greece—to an enforced stay extending over nearly five weeks. The beauty of the water, reflecting Attic skies; the grand contour of hills, with their ever-changing colours; the perfect clearness of the atmosphere; the little modern houses of Corinth, with their green windows and rich vine verandahs; and the sometimes quaint, and always picturesque, fishing-boats and fishermen of the Gulf of Corinth, gave much to please the eye and disturb the monotony. The sunsets, too, were glorious, more so than anyone who has not seen a Grecian sunset can realise. But after all, if one is unfortunately not a poet, it is quite possible to get so accustomed to the beauties of nature as to take little notice of changing tints on the "everlasting hills," the beauty of the water, or the glory of the sunset. Justin McCarthy, in one of his recent novels, says something to this effect in reference to the hills of Greece: "It might make a very waiter poetical to look upon those mountains, outlined against the sky, of many, many tints—of all tints, from pearly grey and faintest green to passionate flame and purple." But then, you see, Justin McCarthy's waiter did not have to stay looking at one lot of hills for upwards of thirty days, the only excitement open to him by way of a change being a morning and evening swim, and the wild pleasure of going twice a day to the railway station to see the train come or go. If he had, he would no doubt have given up the poetic line, and elected to go back to his normal duties "to fetch and carry, come and go." A stay at Corinth, however, imposes certain duties, and they are, to lovers of the antique, a visit to the top of the Acrocorinthus and to the site of the ancient city; and to those, on the other hand, whose interest centres more in the advance of science and of great modern engineering, an inspection is imperative of the progress of the canal which will unite the Gulfs of Athens and Corinth, and shorten the road so considerably to Constantinople and the Black Sea. With the second of these duties, therefore, in view, the writer one broiling day in June determined on doing the canal from end to end, and having arrayed himself in the thinnest garment imaginable, set out on the tramp. From Corinth to the entrance of the canal is about a mile and a-half, but with a blazing sun overhead and burning sands under foot. Sandwiched as the walker is between two fierce heats, the walk can hardly be supposed to afford unlimited pleasure. There is a so-called carriage-way from Corinth to Posidonia—the new town at the entrance to the canal —and carriages can be had at Corinth; but as the road at this time of the year is little less than 6in. deep with dust, a tramp along the sands, with the option of cooling one's feet, boots and all, in the little waves now and then, is certainly the lesser of two evils. The town, or rather village, which rejoices in the very magnificent name of Posidonia, at present consists of a number of wooden houses of barn-like architecture, apparently designed by the same architect who prepares the elevations of the houses which toy tradition has taught us to believe were in use at the time of Noah. These houses at Posidonia have a peculiar effect, as they are thrown on to the ground without any pretence of a regard for order, and can only be distinguished one from another by the huge figure which each one bears on its end wall, and which covers it nearly one-third. At present these numbers reach to ninety-two or ninety-three, and it is a speculation whether the houses must be increased in size, when the necessity comes for three figures, or the figures be reduced. Already, however, a few really handsome stone houses have been added, but their number is less than half a dozen. Still they no doubt indicate what Posidonia is going to be, and it may safely be taken that when the canal really opens a more or less popular and important town will spring up, for not only will it wipe out the modern Corinth for all commercial purposes, but will be no doubt largely used as a resort for pleasure-seekers in the autumn months, when the sea-bathing and the shooting in the hills are at their best, the famous hot sulphur baths at Soutraki, about a mile round the bay further from Corinth, are in full working order, and when yachting and fishing in the Gulf of Corinth can be indulged in with the greatest amount of pleasure and the best prospect of sport.



The entrance to the canal, which is to the north of Posidonia, is protected from the effects of westerly winds, which blow very hard in the gulf and soon get up a considerable sea, by a small harbour surrounded by heavy stone and concrete walls, and into which ships will come through a very narrow entrance, perhaps not more than from 80ft. to 90ft. across. The harbour itself, from the entrance to the commencement of the canal, is not more than 400ft. to 500ft., and its greatest width apparently does not exceed 700ft. It is in shape something like a quarter circle, the canal starting from what would be the centre, or twelve of clock, and the entrance for ships being at what we might call half-past ten of the circle. Within the harbour there is a depth from five to eight fathoms; immediately outside the sounding is 30 fathoms, and within a mile it reaches to a depth of 160 fathoms; indeed, the little steam tugs have only to take the laden barges a very few yards outside the harbour to allow of the discharge of earth which has been taken from the lower or water level of the canal. As we enter the canal we see on the right or south bank, first a substantial, though small, stone house, for the accommodation of the foreman or entrance keeper of the canal, and a few yards further on an extensive workshop has been built, in which are departments for fitters, turners, blacksmiths, carpenters, &c., provided with necessary lathes, drilling machines, forges, hammers, &c., for the conduct of any repairs which may be necessary to barges, dredgers, wagons, permanent way, or engines. A fine pair of shear legs has been erected in front of these workshops, fitted with all necessary winches and gear for the lifting of anything in use in the workings, and under which the great steam dredger Posidonia was placed, having her buckets changed or repaired on the day of which I write. On the northern side of the canal, and perhaps 100 yards above the workshop, a recess has been cut into the bank of sufficient dimensions to accommodate a little floating dry dock, capable of taking on for cleaning, repairs, or otherwise, any of the smaller craft, including the tug boats and mud barges. When I saw it, it was occupied by a floating crane of considerable size, which was undergoing a clean up and having a new coat of paint. Behind the little dock is a beautiful stretch of vineyard, and as waving corn-fields abound between the canal and the ranges of grand hills on either side, those travellers who associate the name of canal with the dreary passage from Port Said to Suez will be agreeably disappointed when they first make the run from Posidonia to Isthmia. With the exception of the little floating dock, the northern side of the canal at this end will be without houses, or work of any kind, so that all the space is available for depositing the earth and stones—in the form of a big plateau—which has been, or will be, taken from the workings above the water level. No doubt this great plateau will be turned into use or ornament when the canal has been finished, for the earth is more or less rich; there is an absence of sand or stones, and vines or corn will flourish on it. Continuing our walk on the southern bank, we come, after the workshops, to a great store of patent fuel, which is used in all the tugs, dredgers, locomotive and portable engines at work in the canal cutting, and about 100 yards further up a large, handsome stone house, fitted with verandahs, balconies, gardens, and every modern improvement, has been erected for the director and officers of the western end of the canal. For a distance of about half a mile above this house, or perhaps three-

THE ISTHMUS OF CORINTH CANAL.



VIEW FROM THE TEMPORARY BRIDGE.

VIEW FROM THE RAILWAY BRIDGE.

quarters of a mile altogether, the canal is finished and dredged to its full depth; its sides are formed of very hard clay—so hard, indeed, that the men are obliged to face it with picks—and it looks as though it had been really cut through rock, with its hard, straight top line, and perfectly flat, even, sloping sides. The sides are parallel so far as the work is yet finished. Up to this point the work has not been of a very heavy kind, as the level of the surrounding land is low, the water not being more than about 12ft. to 14ft. below the level, but from this point the land rapidly rises, and the great work of the Corinth Canal begins. At the present head of the waterway of the canal, so far as it goes, a large steam dredger is working, with a line of barges on either side, into which the earth is thrown. The bed is formed of some peculiarly hard earth or very soft stone, and the cutting edges of the buckets of the dredger are fitted with a number of heavy sharp iron or steel teeth, which usually bring up the earth in small pieces, but very often a bucket comes up carrying a huge piece of solid earth or stone, which necessitates the stoppage of the machine, while in answer to the shrill whistle of the captain, men come forward armed with great long chisels and heavy hammers for the purpose of reducing this before-mentioned big piece to such pieces of a smaller kind as will adapt themselves to the size of the tipping part of the machinery above and that of the shoots.

The dredger is moored securely by means of heavy chains and anchors ashore, and round steam gear on board; the captain occupies a little house at the bows of the craft, and by means of a whistle, upon which he can blow different calls—a species of boatswain's whistle—he directs the work, pulling on the port or starboard chains, or stopping the whole of the huge machinery, as he pleases. At the place where the dredger works, the level of the ground in front has been brought down to about 5ft. above that of the water by means of hand labour, the loose earth being thrown into little wagons running on De Cauville portable rails, which wagons are pushed along to the edge of the level and tilted, allowing the earth to drop in front of the dredger, by which it is again lifted, deposited in the barges, and taken out to sea. So far, therefore, we have two levels, that of the canal in which the dredger is working, and the level 5ft. above that on which the first system of De Cauville wagons is working. This second level extends at present about half a mile, and then rises to a third level, which is approximately 10ft. to 12ft. above it, or 15ft. to 17ft. above the water level, and this third level is now the position of the main work at the Corinthian end. This level, which we may call the third, runs for a distance at present of perhaps a little more than a mile, and as the country rises rapidly, its surface is in places 120ft. below the level of the surrounding land, the sides being cut into the hard earth perfectly perpendicularly. At the northern side of this level the work is in progress, and being carried out vigorously, of reducing it to the second, or 5ft. stage, a channel having been run along almost the entire length about 10ft. broad by 10ft. to 12ft. deep. In this channel two lines of De Cauville rails have been placed, upon which a large number of little tilting wagons are running; at the western end of this channel there is an inclined plane, up which the full wagons are hauled by a 12-horse power Hornsby portable engine, the empty wagons being allowed to run down at the same time. The loaded wagons are pushed along by men, and formed into a long line, which, when judged to be sufficiently long, is attached to a little ballast engine, drawn away to the plateau spoken of before behind the floating dock on the northern side, and there discharged. Nothing could be better suited to this work than the De Cauville railways, for the lines are so quickly laid, and the little wagons, though capable of carrying a very good load, are so light, that should they upset they can be easily replaced on the line by one man. It may perhaps be fair to remark here that the labourers employed over the whole of the canal works are magnificent specimens of Montenegrins, who come from the Black Mountains, and are known in Greece as Mavro Vrunies. They are, generally speaking, peculiarly tall men, and of light, though powerful physique; the average height of any hundred of them would not be less than 6ft., and more probably 6ft. 1in. In physiognomy they are more like the Danes than any of the southern nations, and they are remarkable over all the Mediterranean for their personal beauty and great pluck. They are skilful navvies, and it is no uncommon sight to see one of them standing on a little projecting piece of earth 50ft. or 80ft. above the level, and with his crowbar or pick, literally hacking the ground from under his feet. He is, however, always ready to leave the projection exactly at the right moment, and the next stroke after he has left it seems to send it crashing and tumbling down below. Should the fall be soft or short, he will not trouble to move, but will work away until he goes, he never seems to fall, with the projection. No Greeks are employed in the works, as they are found to be too faint-hearted, besides lacking in muscular power, to render them of much service; and the main amount of the labour is supplied by the Montenegrins, supplemented by some hundreds of Italians, who are also excellent navvies, and a large number of Austrians. The officers, directors, draughtsmen, and clerks are nearly, if not quite, all Frenchmen, the foremen and overlookers are generally Italians, and the men are as we have mentioned above—in all probably about 4000 men being employed in the work.

being left for the new one, and the line at that part was laid down to lead to the new bridge, being only for the moment deflected so as to cross the old makeshift bridge. At present the main carriage road between Corinth and Kalamaki, and so on to Magera, Eleusis and Athens, crosses the canal workings at a great height, a little more than a mile to the east of the new bridge, passing over a wooden bridge erected for the convenience of the moment; but as the road runs beside the canal, it can be carried over the new bridge as arranged with ease.

Beyond the railway bridge, not more than 300 yards, the land reaches its highest point, and the cutting at either side is, or will, be a perpendicular precipice upwards of 300ft. deep to the level of the canal, and extending for a distance of about a mile and a half. At present the greatest work of the canal is being carried out in this cutting, where some 3000 to 4000 men are employed digging, cutting, blasting, and shovelling earth, sand, clay and rocks from three levels or steps at each side. Two lines of rails run along the bottom of the cutting, and upon these an ever changing series of trains of wagons are ready to receive and steam away with the hundreds of tons of earth, &c., coming down every day. The top step, on the day under notice, stood about 75ft. above the rails, and from it the labourers were throwing the earth over the heads of the men working on the lower steps into the wagons, and it would be very difficult to convey any idea of the noise, the dust, the shouting, the shrill shrieking of the engines, and the blinding, sweltering heat of the whole scene. A small army of boys is engaged supplying water to the thirsty labourers from wooden barrels, which are carried on the head, and which very quickly warm up under the almost tropical heat. The men, especially the great Montenegrins, seem to work with untiring industry, clothed in a thick flannel of marvellous architecture, and

necessary repairs. On the southern hills, and within various distances of the canal, a large number of pretty villas—some of which might claim to be called handsome houses—have been built, and are at present occupied by the engineers engaged in the works, or by gentlemen who admire the natural beauties of the place and appreciate the fresh breezes from the hills, and the almost perfect bathing which is here to be had. The earth taken from the upper workings of the canal at the Isthmian end is deposited on an already huge embankment on the northern side of the town, and certainly robs that part of the country of any claims it might have advanced to beauty or picturesqueness. As at the Corinth end, the waterway of the canal has been here completed for a distance of about half a mile, and is to a certain extent a repetition of the work already described at Posidonia. Owing, however, to the more rapid rising of the land at the eastern end, the tunnelling begins much sooner than was necessary at the western end. That the canal will be a great work of engineering when finished there can be no doubt; but that it can ever pay as a commercial investment is a question of quite a different character. No doubt it will be used to a very large extent by vessels to or from the Adriatic, but their numbers are few and far between, while vessels from the Black Sea or Constantinople for Mediterranean ports, or *en route* for Gibraltar, will beyond question prefer to pass round Capes Malia and Matapan to incurring the delay and the expense of a passage through this canal. The projectors have gone into this question fully it may be supposed, and have assured themselves that the venture will pay; but to a mind unsupplied with official data as to probable tonnage, however much local knowledge may be possessed, the scheme seems doomed to failure as a money-making enterprise.

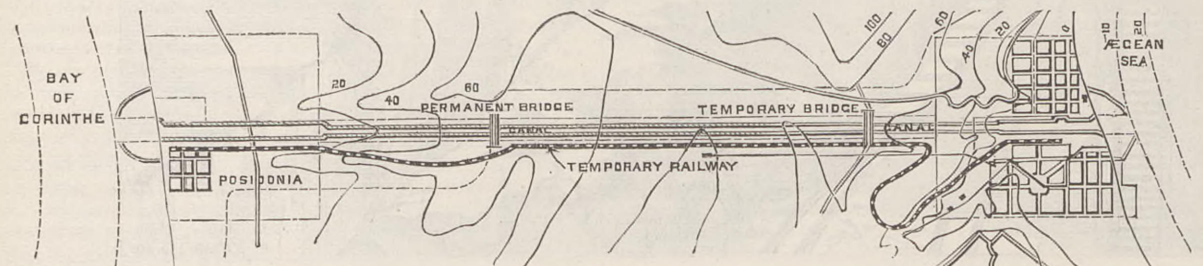
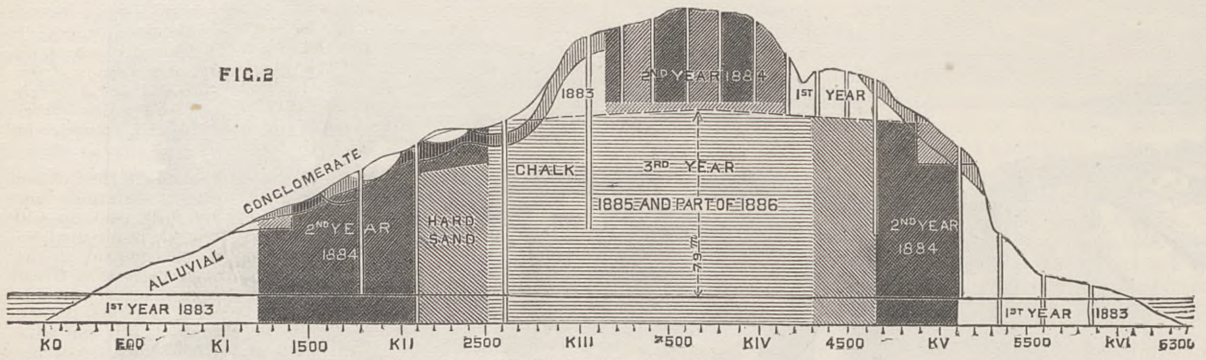


FIG. 1

PLAN OF CANAL.

FIG. 2



SECTION OF CANAL.

The floor of the level which I have called the third level is quite square and smooth, and carries three lines of heavy wooden wagons for the removal of the earth; these wagons run on a broad gauge, that is to say, a 4ft. 8in. gauge, and are drawn by powerful tank locomotives built by the Societé des Ponts à Travaux en fer, Paris. The earth from the sides at the upper end of this big cutting is thrown from above into the wagons, which, when full, are drawn away by their engines in long trains, and emptied into the great northern plateau at Posidonia. At the head of the cutting a tunnel capable of carrying one line of rails is driven into the hill for a distance of about a mile. It is lined and supported by means of heavy timbers placed close together. High above the tunnel and from the top level of the ground a number of craters, looking like enormous funnels, have been dug or blasted with dynamite or other explosive; the apex of these inverted cones pierces into the tunnel below, the opening being heavily shored; the bases of these are in diameter about 80ft., and the opening about 4ft. square. All round the sides of these funnels, of which there are about eight or nine, the men are hard at work, picking, digging, and blasting, the wagons below being moved as rapidly as they are filled. Half a dozen of the best men are employed round the discharging hole at the bottom of the funnel to keep it clear and always in working order, and it can readily be imagined the lively time they have of it, for not only have they to attend to their own business but be ready ten times a minute to get out of the way of the avalanche of rocks and earth, which comes tumbling down on the cry of "garda!" from the men above. They, however, never seem to come to grief, and have learnt by experience to judge to an inch where any great piece of rock or lump of earth will fall, and while working themselves industriously they seem to have eyes all around, and to know almost by instinct where to look out for danger from. Of course when the blasting charges are all ready to be fired, the men are called up from the funnel, as they seem to draw the line of danger only there. A few yards to the east, along the canal, and from the last of the craters, and about $1\frac{1}{2}$ to two miles from Posidonia, a splendid piece of work is to be seen in the iron road and railway bridge which will carry the railway line across the canal on its way from Corinth to Athens, as well as the high road between these places. The present railway line crosses the canal works over a little old-fashioned bridge beside the new one on the west side; the old bridge was merely put up as a temporary makeshift, the best site of course

with only a cap of the smallest dimensions—if they at all indulge in the luxury of head gear. The work in this Pandemonium of a cutting is directed by a number of gangers, or charge men, who carry their wishes to the men immediately under their orders by means of peculiar whistle calls, after the style of a man-of-war's boatswain. This cutting may be said to be bounded on the west by the new railway bridge, and on the east by a ramshackle temporary wooden bridge, which at present serves to carry the highway traffic between Corinth and Kalamaki across the workings. A sketch which I took from this bridge, looking towards Corinth, gives a very fair idea of the cutting, with the railway bridge in the distance; but I have left out the picturesque crowd of workers. From the temporary road bridge the ground rapidly falls to the sea, and after a few minutes' very hard down-hill work, the new town of Isthmia at the eastern end of the canal is reached. This town is situated at the apex of a small bay in the Gulf of Athens, or Acquia, and is about a mile round the beach from the town of Kalamaki. When the canal has become a *fait accompli*, Isthmia and Posidonia will rise to importance as Kalamaki and Corinth decline.

A breakwater has been constructed across the entrance to the canal at this end, which will protect it from the effects of an easterly wind and sea, and will allow of vessels entering at any time without consideration for wind or weather. Behind the breakwater which joins the northern shore, a V-shaped bay, faced at either side with heavy stone walls, leads to the canal, and as this bay is of considerable area, several steamers waiting to enter the canal could be anchored within it in safety. On the southern side of the bay a beautiful residence has been built for the general director of the canal, and as this house is provided with very extensive well-planted gardens for fruit and flowers, having extensive conservatories and verandahs, as well as a private pier into the waters of the gulf for bathing, boating, or, as it is fitted with a little summer-house, for dinners, the appointment of general director, at least in so far as his quarters are concerned, is not one lightly to be refused. Abutting the grounds of the director's house a large stone building has been constructed for the offices and for the accommodation of the officers, and just below this is a floating dock for boats, dredgers, cranes, &c. On the other side of the harbour, and at the entrance to the canal, there is a large workshop, containing departments for turners, blacksmiths, carpenters, fitters, &c., in front of which the steam dredger Isthmia lay, receiving some

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Robert Harding, engineer, to the Lizard; George Aborn, engineer, to the Vesuvius; Josiah H. Hunt, engineer, to the Hecla; Edward J. Rutter, assistant, to the Devastation; George White, chief engineer, to the Scout; William F. Stewart, engineer, to the Scout; William H. Gale, engineer, to the Helicon; James J. Walker, engineer, to the Grappler; James B. C. Warrington, engineer, to the Cherub; Henry Lane, engineer, to the Hotspur; Charles A. Harding, assistant engineer, to the Fearless; Fred Hore, assistant engineer, to the Scout; William Gilbert, staff engineer, to the Belleisle; Thomas J. Comber, engineer, to the Penguin; and Albert Martell, engineer, to the Asia, as supernumerary.

Death of Mr. E. A. Gerrard.—We regret to record the death, through an accident, of Mr. Ernest A. Gerrard, the engineer of the mines at Rochebelle, near Alais, France. The *Mémorial de la Loire*, in a lengthy account of the accident, which happened August 20th, states that Mr. Gerrard, in company with one of the foremen, was examining the mine, when the side of the gallery they were in was suddenly broken through by a rush of water, liberating a quantity of carbonic acid gas. The water carried with it masses of coal, &c. The lamps carried by Mr. Gerrard and his foreman were, unfortunately, put out. A rush was made for the bottom of the shaft, and the foreman escaped, but Mr. Gerrard, falling against a wagon, was caught in the *débris* and killed by the gas before assistance could be rendered. Though only twenty-eight years of age, Mr. Gerrard had won a high reputation in the French mining world. He was widely known in the profession, and greatly beloved in the Rochebelle mining district. His funeral was attended by many thousands of all classes, by nearly all the engineers of the basin, and various delegates and deputations.

The Panama Canal.—Mr. Nathan Appleton, United States Agent on the Panama Canal, has made an important and hopeful report respecting the Panama Canal, which, the *New York Herald* says, will be published in the next bulletin of the American Geographical Society. Mr. Appleton says:—"Now comes the natural question when the canal is likely to be finished and open for navigation. While we all hope, to please M. de Lesseps, that it may be done in 1889, should there be no convulsions of nature or unexpected hindrances, all the same, looking at it philosophically, a few years more or less can be but of little significance. The canal is to be built for all the nations of the world, and to last as long as this planet endures. As soon as possible it will be opened for ships of from 10ft. to 20ft. draught, and then with time will be completed to its full depth of nearly 30ft. The idea of this is to lose no time in earning some revenue from it. Next comes the question of what it will cost. Looking back at the deliberations of the Paris Congress of 1879, one is astonished to find how correct was their estimate of the expense. It was then calculated that the total cost for, say, ten years of construction and maintaining, with interest on the money, would reach about 240,000,000 dols. In this was not taken into consideration the purchase of the Panama Railway, nor the erection of hospitals, habitations, and many other necessary expenses which cannot strictly be considered as part of the digging, but which run up to some tens of millions. All this has been done, and well done. The work is completely under way, and the din and hum of men and machines resound from one end of the isthmus to the other. Steam and human labour to-day represent there a force of half a million men. Should the canal cost 500,000,000 dols., it will easily be worth that to the world and be a fairly paying investment to the stockholders. In 1879 the traffic through the Suez Canal amounted to about $3\frac{1}{4}$ million tons. It is now nearly 9,000,000. The Congress in 1879 estimated the probable traffic of the Panama Canal in 1889 at $7\frac{1}{2}$ million tons. I do not hesitate to state as my personal conviction from the great increase of trade that 10,000,000 tons at the outset is a fairer calculation. Dues at 3 dols. a ton for shipping alone will give a revenue of 30,000,000 dols. A glance at the map of the world, or better still at a globe, shows it will cause a saving in distance of about 10,000 miles between the great ports of the different nations, or three times across the Atlantic Ocean from Havre to New York. South America stretches much further south than Africa, and the Panama Canal can be reached in a straight line from almost any direction. An objection to the Suez Canal is the long detours ships are compelled to make at either end. During the last few months the work on the canal has been much simplified by giving it to five well-known firms of contractors, whereas before there were not far from thirty in all. These five syndicates report directly to the administration of the canal company, making arrangements with the smaller contractors for work they may sublet to them. This has involved some complications in relation to past agreements, but they are being straightened out so that all shall go smoothly in the future. It is in the interest of the contractors to work as fast as possible, for they are paid so much a cubic metre for soil excavated or dredged. It is for the advantage of the canal company to have the canal completed and open as soon as possible, as this means a saving of interest on the stock and bonds. So increased activity is the object of all concerned. Of the five firms of contractors three are French, one American, from New York, and one Anglo-Dutch. Their contracts vary from 15,000,000 to 30,000,000 cubic metres, and the prices from about 40c. to 1 dol. 80c. per metre. There remain in all not far from 100,000,000 cubic metres to be removed, the cost of which can be put down in round figures at 100,000,000 dols. or an average of 1 dol. per cubic metre."

RAILWAY MATTERS.

The new railway on the Queensland side of the border will connect Adelaide, Melbourne, Sydney, and Brisbane.

The *Colonies and India* says it is probable that the net revenue from Indian railways will exceed the Budget estimate by fully 50 lakhs of rupees.

It is said that the Midland Railway Company is about to adopt cast steel disc wheels, with flanges cast on, for their new carriages and wagons and renewals.

After an extended trial of systems of lighting their carriages, the North British Railway have adopted the Pintsch system, and about 250 coaches are to be fitted up at once.

It is stated that work has been commenced on the construction of the Hudson's Bay Railway, and that 2000 men are now employed in connection therewith. The new line will shorten by 1000 miles the distance between Liverpool and the Pacific coast.

The Sutton and Willoughby Railway, of which we gave an account some time since, was opened for traffic on Monday, and places the Midland Counties in direct communication *viâ* Boston with Sutton-on-Sea, situate about three miles from Mablethorpe and nine from Skegness.

The additions to rolling stock, and the capital expenditure thereon, on the South-Western Railway during the five years ending June last were 144 engines, at a total value of £361,958, and average value of £2514; 500 coaching vehicles, £301,512, average £603; 1073 goods train vehicles, £80,033, average £75; total, £743,503.

The scheme for the construction of a railway from Wolverhampton through Bridgenorth to Craven Arms has now been finally abandoned. The necessary powers for making the line were obtained in 1883, when there was a prospect of a successful future; but trade since that time having become so depressed, the projectors believe that their venture would not prove remunerative.

It is the intention of the Highland Railway Company to have the short line between Inverness and Aviemore completed about the same time as the Forth Bridge, which will have the effect of considerably accelerating the journey between Inverness and the south. The Forth Bridge will save one hour between Edinburgh and Perth, and the Highland Company will save another hour between Inverness and Aviemore.

The *Newcastle Daily Chronicle*, of the 29th ult., remarks that Monday—the 27th—"was the anniversary of the opening of our first passenger railway, and though it has been merged in the greater North-Eastern, local patriotism will remember that the line was the old Stockton and Darlington, and that Newcastle had much to do with its making and equipment. It is sixty-one years since that railway was opened, and the locomotive has revolutionised the old world. Mankind will not forget to trace the birth of the great civiliser, the railway locomotive, to the Tyne, and the birth and the development of the railway to the district of Darlington and the Tees."

A *Times* correspondent at Constantinople, writing on October 2nd, says:—"A private letter was received here last week, dated only nine days before, from Merv, by way of the Transcaucasian railway and Batoum. This is sufficient and tangible evidence of the progress made in that quarter by the Russian Government in the means of transport and communication, and shows how the difficulty of conveyance over large tracts, covering broad surfaces on maps, may be surmounted by the aid of modern science. The letter alluded to mentions the system used of housing the workmen in light wooden structures rolling on the line itself as it was progressively constructed, the materials and everything necessary for the works being so carried forward for use on the spot as required."

The Jubilee of Railways will be celebrated in Paris next year. There will be held:—(1) An international exhibition of railways, and of industries connected with them, which will be open from May to October, 1887. (2) An International Congress, composed of delegates of railway companies, chambers of commerce, syndical chambers of trades, scientific societies, and others. The jubilee of railways is under the patronage of the ministers of public works, industry and commerce, agriculture, post and telegraphs, war and marine, of M. Ferdinand de Lesseps, and of over 150 gentlemen representing the Municipal Council of Paris, the Senate, the Chamber of Deputies, Chambers of Commerce, Syndical Chambers of Trades, manufacturers, and others. All information can be obtained at the London offices, New Broad-street House, London, E.C., of the Commissioner-General for England and the Colonies.

Some very interesting experiments have been made in the United States to test the effect of open and close couplings upon the ability of a locomotive to start a train. This has been a matter of hot dispute for a good while, and it is strange that the matter was not long ago determined by actual experiments. At Burlington it was found that the locomotive could start level forty-nine loaded cars close coupled and forty-eight with ordinary link and pin coupling. Afterward, on the grade, the engine started thirty-eight cars with each method of coupling. The general results seem to establish the conclusion that the loose slack of open couplings is of no advantage in starting a long and heavy train, and that the draw-bar springs give all the slack that is needed. This is opposed to the results of English experience, which show that slack in the couplings is essential to the starting of heavy trains. How much slack is an open question.

The Russians seem to be pushing their railroad enterprises in far-off Turkestan with something akin to American energy. Within a month they have crossed the Murghab river at Merv, very near the Afghanistan border; and from there will complete the line north-eastwardly to Charjui on the river Oxus, a distance of about 170 miles further. This latter length they expect to finish in November next. With the road to Charjui completed, the Russians will have an all-rail line extending from the Caspian Sea about 900 miles eastward, well into the heart of Central Asia. From Merv, just north of the Afghanistan border, to the Bolan Pass, on the southern boundary, is about 700 miles as the crow flies. But as Kandahar, towards which point the Indian railways are now being pushed through the Bolan Pass, is 200 miles nearer, we can say that but 500 miles of road must yet be located to connect the Caspian Sea with the Indian Ocean. The construction of this missing link of railway will be difficult and very expensive work; for the line will have to cross the mountainous watershed dividing the rivers of the Indian Ocean from those flowing into the Caspian and northward; and these mountains are high and abrupt and the various ranges cover a wide extent of country.

A new railway in the United States will traverse a natural tunnel. The tunnel, which has been formed by the action of Stock Creek, the largest fork of the Clinch River, extends in a slight curve 933ft. through the solid rock of a hill, with perpendicular sides, and 480ft. high at one entrance and 592ft. at the other. The spring of its spacious arch is from 100ft. to 110ft. above the floor, and the width is about 110ft. Through this broad and roomy passage the waters of Stock Creek flow in a gentle incline, occupying but a portion of the space, and so slight is the grade that the track of the new road can be laid upon the rock floor with but little labour. The rock is a hard limestone, and countless ages must have passed before the waters of the creek burst through the adamantine barrier, and cut out a noble arch. The new road, which will make a practical use of the tunnel, will run from Bristol, Tenn., Big Stone Gap, Va., on the Kentucky State line, a distance of eighty miles. About forty miles of it have been graded, and it is under contract to be finished in two years. Had it been necessary to tunnel through the mountain, the company must have spent at least 500,000 dols. The coal found in the country is cannel, bituminous, and splint, and will be carried to the seaboard by the Norfolk and Western Railroad for shipment.

NOTES AND MEMORANDA.

In a recent number of the *Organ für die Fortschritte des Eisenbahnwesens* is a paper, by M. Krüger, on "Conical Tires of Railway Rolling Stock," in which the author shows these to be a cause of resistance to traction and of the travelling of the rails.

It is claimed that by a new process white wood can be made remarkably homogeneous and tough. The result is said to be obtained by steaming the timber and submitting it to end pressure, thus compressing the cells and fibres into a compact and inextricably interwoven or interknotted mass.

Mr. E. D. Wassell, of Pittsburg, Pa., has invented a new process of welding steel, by which steel bars of any content of carbon can be piled and welded together. The *Engineering and Mining Journal* says he has demonstrated this by making a homogeneous weld of a pile made of bars containing 0·65 per cent. of carbon, and the carbon reduced to any point desired; that is to say, steel of 0·65 per cent. can be reduced to 0·10 per cent. carbon while in the solid form without remelting.

Two of the largest castings in the world are said to be at Nara and Kamakura, Japan, the one at the latter place being 47ft. high, and the other, at Nara, being 53⅝ft. from the base to the crown of its head. The statue at Nara is supposed to have been erected in the eighth century, but it was destroyed and recast about 700 years ago. In endeavouring to recast it several mishaps occurred, and when at last success came, some thousand tons of charcoal had been used. The casting, which an American contemporary says is an alloy of iron, gold, tin, and copper, is estimated to weigh 450 tons.

The reports just returned by the Vienna Central Commission for statistics on the state of the population at the end of 1885 yield a very unfavourable result. The rate of births has considerably decreased, while that of deaths has increased, and there has been a diminution in the number of marriages. The number of births last year amounted to 860,663, against 878,321 in the year 1884, and the number of deaths amounted to 689,493, against 666,523. The number of marriages amounted to 175,233 in 1885, against 179,171 in 1884. Clearly Vienna is not likely to require any great extension of its public works.

In a paper read before the British Association, "On the Chemistry of Estuary Water," by H. R. Mills, D.Sc., the salinity—ratio of total dissolved matter in water—was given from point to point in the Firth of Clyde and Firth of Forth. The distribution of salinity was shown to be constant all the year round, whilst in the Clyde there are periodical variations through the whole mass of the water. In the Forth river entrance it is evident a mixture of river and sea water takes place by a true process of diffusion, maintaining a constant gradient from river to sea. The dissolved matter of fresh water was found richer in calcium carbonate than sea water.

Mr. T. Turner, of Mason College, Birmingham, states that no general rule can be laid down as to the influence of re-melting on the properties of cast iron; chemical changes take place during the melting; the amount of silicon is reduced whilst that of the sulphur is increased, and the effect of re-melting will be dependent upon the proportion of these elements present in the cast iron; a single melting will be sufficient to produce a deterioration in the qualities unless the silicon is in excess. Addition of silicon to hard white iron causes it to become soft and grey, and too much silicon makes the iron weak; by adding silicon in right proportion cast iron can be made of any desired degree of hardness.

Professor Dr. Meidinger states that Professor Poleck has discovered that timber procured for him purporting to be winter-felled wood, was in reality raft timber floated down the river, and he has ascertained that timber which has been thus immersed is no longer liable to the attack of dry rot. So much so is this the case that in Alsace it is customary to specify that only raft timber shall be employed. The water slowly dissolves out the albumen and salts, and thus deprives the fungus of the nutriment needful for its development. A French savant has found by experiment that whereas fresh sawdust, when buried in damp earth, rots away in a few years, sawdust which has been soaked for some time in water, and has been thereby deprived of soluble matters, will remain in the ground under similar circumstances wholly unchanged, and only slightly tinged on the exterior with earthy matters dissolved from the soil.

The iron used for bridge construction on the Bavarian State Railway must possess a tensile strength of at least 320 tons per square decimetre—20·5 tons per square inch. The material used for rivets must be capable of being bent double, and a cylinder of height equal to two diameters must be capable of being worked cold to half its height without, in either case, any cracks or signs of extreme distress being visible in the iron. Only cast steel is used where steel is required. To prevent the formation of rust, the iron is treated in the following way before being put together: It is dipped in dilute acid, washed in lime water, well rubbed until clean, immersed in boiling water, and when it has acquired the temperature of the water, it is taken out, painted with hot linseed oil, and then with non-corrosive paint. As deteriorating agents, the vibrations and sudden shocks due to a live load are considered second only in importance to the formation of rust.

In an article on "Old Bridges Under New Loads" in the *Journal of the Association of Engineering Societies*, 1886, p. 159, an abstract of which is given in the "Proceedings" Institution of Civil Engineers, it is stated that with the increased speed demanded by the development of traffic in late years, both locomotives and cars are now constructed of considerably greater weight than was customary when the largest percentage of existing bridges was erected. In freight and passenger locomotives the increase in weight during the last ten years has been about 50 per cent., and in cars nearly 80 per cent. Bridges built for standard loads in 1876 are now therefore overstrained from 25 to 50 per cent. in different members. This is in relation simply to dead load. With regard to the mechanical effect of moving load, expressed by the formula $E = 2\frac{v^2}{2g} W \sin.\ \alpha$, E being directly proportional to the square of the velocity, where the speed is doubled the mechanical effect is multiplied by 4. With a speed increased within the last ten years by nearly 50 per cent., and the increased dead-weight of rolling stock, the strain on bridges designed under the old conditions is now multiplied by 3.

M. G. A. Hirn recently presented to the Academy of Sciences of Paris a new work entitled "Modern Kinetics and the Dynamism of the Future," together with some remarks explaining its general purpose. After replying to the various objections raised against his general principles, he deals with the arguments which, as he maintains, render henceforth indefensible the kinetic theory of the gases, referring to molecular movements most of the properties of these bodies. Three arguments are advanced, of such a nature that he believes future physicists will wonder how this kinetic theory could ever have been accepted for a single moment. Even were it correct, it would not follow that light, radiant heat, electricity, magnetic attraction and repulsion, and gravitation were due to movements of ponderable matter, far less that thought itself was nothing more than a molecular movement. But the reverse is not true, so that with the collapse of the kinetic theory of the gases fall the kinetic theories in general, which claim to explain all possible phenomena of the universe by invisible movements of matter. The doctrine here substituted for kinetic force, he thinks, explains quite as easily, and much more rationally, the universal phenomena of the physical world. He does not, however, hope at once to convince all minds of what they should have long ago been themselves convinced. Interpretations formulated *a priori*, and apart from experience and observation, have, unfortunately, more vitality than truths gained to science by the patient study of Nature.

MISCELLANEA.

The Liverpool Corporation have adopted the Pintsch system of gas lighted buoys for the Liverpool port.

A new edition of Trautwine's "Civil Engineer's Pocket-book" is announced by Messrs. J. Wiley and Son, and by Messrs. E. and F. N. Spon.

An experimental attempt to carry logs from Canada across Lake Huron on a huge barge fitted up for the purpose has, it is said, proved a failure.

A new edition, the 12th, of Trautwine's "Curves for Railroads," is announced by Messrs. J. Wiley and Sons, and by Messrs. E. and F. N. Spon.

Messrs. Follows and Bate announce that their address will henceforth be Gorton, Manchester, where they have new and extensive works.

At the quarterly meeting of the Company of Plumbers, Alderman Stuart Knill was elected Master, and Messrs. F. Machin and W. H. Bishop Upper Warden and Renter Warden respectively.

Messrs. Hartley and Arnoux, of the California Engineering Works, Stoke-upon-Trent, have admitted into their partnership Mr. Walter H. Fanning, the name of the firm being now Hartley, Arnoux, and Fanning.

Messrs. Yarrow and Co. are completing a stern wheel steamer of an exceptionally shallow draught, for the transport of troops in connection with the Burmah expedition which will take place next winter. This vessel will be of the same type as those constructed for the Nile expedition by the above firm, and which proved so invaluable during the operations in Upper Egypt.

The Kimberley Waterworks have been connected telephonically with the reservoirs and out stations, the greatest length of wire in one circuit being seventeen miles. Over this distance verbal communications can be dispatched with the greatest facility; and the result of the trial is so satisfactory that a movement is on foot to establish a regular telephone company in the city.

It is said that a cement manufactory will be established in Macao, China, an agreement having, it is reported, been signed by a solicitor of Hong Kong with Bishop Medeiros for the concession, for a term of twenty-five years or more, of the pleasure-ground known as the Ilha Verde, the property of the mission, at a royalty of 10 dols. for every 100 tons of cement made, in addition to a small annual rental. An American contemporary says the company to work the factory will have a capital of 50,000 dols., and the head office will be in Hong Kong.

A meeting of the Chesterfield and Midland Counties Institution of Engineers takes place to-morrow in the University-buildings, Nottingham, and the following papers will be open for discussion: Mr. G. S. Bragge's paper, "The Geology of the South Derbyshire and East Leicestershire Coalfields;" Mr. James Mansergh's paper, "Burton-on-Trent Sewage Disposal Works—Description of Pumping Station, &c;" Mr. A. H. Stokes' paper, "Notes upon the Report of the Royal Commissioners on Accidents in Mines;" and a paper on "The Theoretical Action of Steam Injectors," by Mr. Henry Fisher, Nottingham, will be read or taken as read.

During the approaching winter a course of lectures on the "Properties of Metals and Alloys and their Uses in the Arts" will be given at King's College, London, on Mondays, from 8 to 9 p.m., and a course on "Fuels: their Uses and Economy," from 7 to 8 on the same evenings. Both courses will be addressed chiefly to young engineers, and to those who have to deal with the applications of the metals or of fuel to the arts and manufactures. The Metallurgical Laboratory for practical work and metal testing will be open on Friday evenings from 7 to 9. The opening lecture on fuels will be given on Monday, October 11th, at 7 o'clock, that on metals was delivered on the 4th inst.

At a meeting, on the 1st inst., of the shareholders in the London Traders, Limited, to whom the Great Eastern steamship now belongs, a dividend of 20 per cent. on the fully paid up £10 shares was declared. This will not be dividing the profits realised to 31st August last, since the registration of the company on the 31st October, 1885, by some 3 to 5 per cent.; so the steamer Great Eastern is now bringing in her present owners about 28 per cent. per annum. The number of visitors on board at Liverpool to 25th ult. since the opening on the 12th of last May is 522,248, and after the termination of the present charter with Messrs. Lewis this company intend exhibiting her themselves.

Mr. James T. Milton, well known as one of the principal advisers of the Engineering Department of Lloyd's Registry, has, we understand, entered upon the management of the St. Peter's Works of Messrs. R. and W. Hawthorn, Leslie, and Co. Mr. Milton's professional career was begun in Portsmouth Dockyard. He distinguished himself as a student of the Royal School of Naval Architecture, and previous to joining Lloyd's register he had considerable experience at sea in the Royal Navy. Besides his connection with Lloyd's Register, he is well known from the papers he has read and the part he has taken in the discussions on professional subjects at the Institutions of Naval Architects, Civil Engineers, &c. Mr. Foley, Mr. Milton's predecessor, proceeds to Naples to undertake the management of the works of the Hawthorn-Guppy Company in that city.

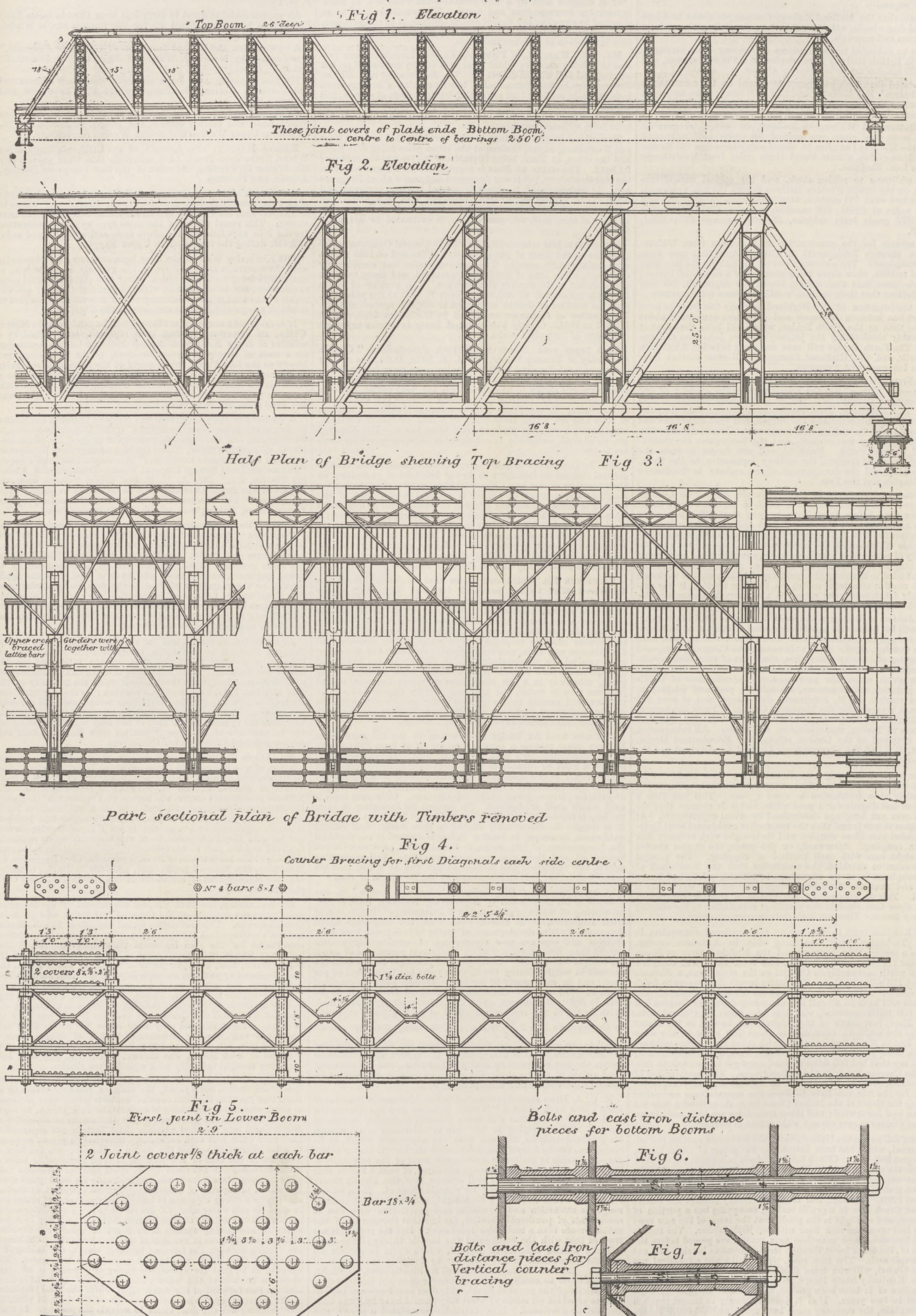
On Wednesday, the 29th ult., an illustration of the fire-extinguishing power available at the Colonial Exhibition was given the Commissioners. The first engine tested was one of Shand, Mason, and Co.'s metropolitan pattern engines, part of an equipment of three constructed for the Fire Insurance Companies' Brigade, of Melbourne. Steam was rapidly raised from cold water, and the engine threw, first, one 1⅛in. jet to a height of about 160ft., this being replaced by two and subsequently four jets, showing the ease with which the engine could be managed. Another and more powerful engine by Messrs. Shand, Mason, and Co., of a type known as treble equilibrium, familiar to the manufacturing districts of Yorkshire and Lancashire and the North, was then set to work. Eight minutes only were taken to obtain from cold water the full working pressure of 100 lb. of steam, when a powerful 1½in. jet, throwing 900 gallons per minute, and rising to a height of over 200ft., was thrown. Four 1in. jets were subsequently brought into play with equally good results.

A correspondent of *The Marine Journal*, U.S.A., criticises the hull of the Scotch built yacht, the Galatea, recently beaten by an American yacht in the International contests which have attracted so much attention. Speaking of the Galatea in dry dock, he says: "What surprised me most was to see the marks of corrosion so deeply eaten into the steel plating. The bottom was reported to have been quite foul with barnacles. Somebody's patent composition for preserving against the action of the elements has been of little use in the case of the Galatea, as in so many other cases of metal bottoms. It has come off in spots and let corrosion take place. The surface is really too rough already for the highest speed the model is capable of attaining. This impairment of surface constitutes a strong objection to building racing yachts of either iron or steel for salt water use. Of course there is a great difference in metals and in methods of preservation, but the best way to secure a smooth and lasting surface is to build of wood or composite. But the worst defect in the skin of the Galatea is the collapsing of the plating between the frames; in other words, the taking of a corrugated form from the inward pressure of the water. The worst of it is, that for speed, the fluting of the skin is at right angles to the run of the water; and the worst spots have their location just forward of the mast, right where the head resistance is the greatest, and where the leverage of the bow in pitching and 'scending has the most effect to wrinkle the plating. In such places, manifestly, the metal should be of greater thickness. There are plates on the Galatea, at this early period of her lifetime, that should be condemned for a racing surface, if not for weakness."

BUENOS AYRES AND ENSENADE PORT RAILWAY BRIDGE OVER THE RIACHUELO.

MR. EDWARD WOODS, PRES. INST. C.E., ENGINEER.

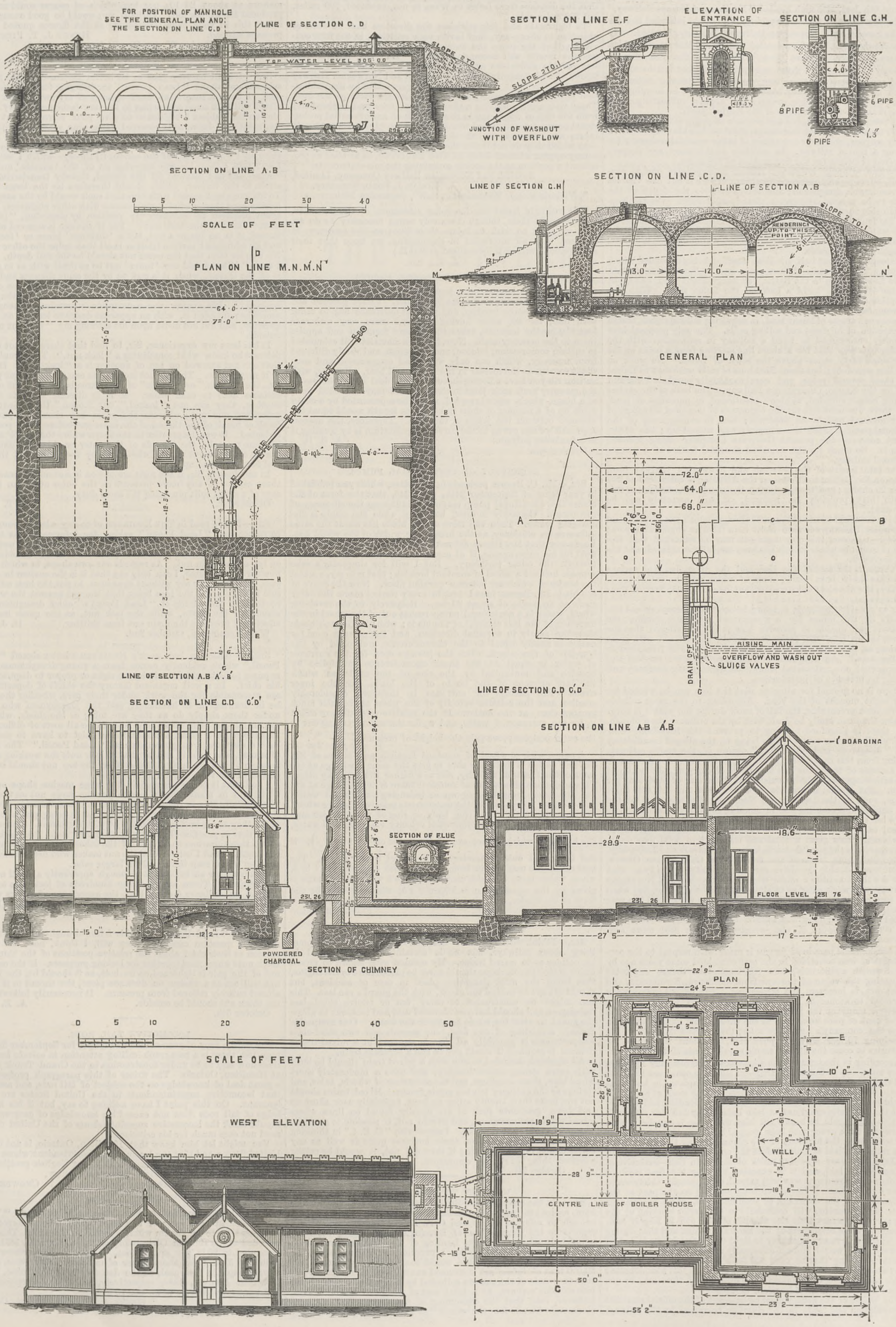
(*For description see page 290.*)



PETERSFIELD SEWERAGE AND WATERWORKS.

MR. HENRY ROBINSON, M. INST. C.E., WESTMINSTER ENGINEER.

(*For description see page 290.*)



LETTERS TO THE EDITOR.

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

THE SWEDISH AND NORWEGIAN RAILWAY COMPANY.

Sir,—The prominent article which appeared in your paper of August 6th last, although headed "Northern of Europe Railway," the former name of this undertaking, is no doubt intended to refer to the Swedish and Norwegian Railway Company, Limited. My directors have had their attention called to this article, which appears to them to have been written with the intention of seriously damaging this great enterprise, and they fail to understand your reasons for so writing, considering that the difficulties which an English company have to contend with in carrying out large works in a foreign country are always sufficiently great without the adverse criticisms of the English press.

My company have shipped and are now shipping to Sweden about 12,000 tons of rails and fastenings, eight or ten locomotives, over eighty wagons, and large quantities of other material necessary for so long a line of railway. In addition to this there are sleepers delivered sufficient for the first section of 120 miles.

The line, although for various reasons an expensive one to construct, offers no engineering difficulties. There is but one viaduct of considerable dimensions; and this, owing to the depth of the gorge to be crossed, requires a clear span of 320ft. On the Norwegian side there are about thirteen short tunnels through rock. The harbour works already executed at Lulea are constructed in deep water, vessels drawing 22ft. being able to lie alongside the railway. Those at Victoria Havn, Ofoten, will allow vessels of 30ft. draught to lie alongside.

Instead of "about half a million sterling being expended" by a company formed some fifteen years ago in "canalising certain rivers flowing down to the Baltic," an insignificant sum was spent in the attempt to build a lock on the Lulea river. With the exception of this trifling outlay, the chief part of whatever capital the company referred to possessed was exhausted in the purchase of enormous tracts of forest land, in acquiring mining rights, and in the erection of furnaces and rolling mills. The only proposal ever seriously entertained to build a railway in connection with the ore-deposits was that for a short line starting from a point on the river some forty miles above the town of Lulea. No work on this line was done; but about 2000 tons of rails were sent to Lulea, lay there several years, and were eventually purchased for and laid on the Nassjo, Oscarshamn Railway. The bulk of the capital having been expended, as above mentioned, in purchase of land, &c, there was none left for the formation of means of transport of their mineral and forest products; and in consequence of the financial panic of 1866 the company was wound up; the subsequent concern—the present Gellivara Company—being founded upon it. So much for the so-called financial failure of a former proposed railway.

The total length of the Swedish and Norwegian Railway from Lulea on the Baltic, to Ofoten on the Atlantic, is estimated at 291 miles 20 chains; and though during the course of construction this length may probably be reduced, it will certainly not be increased.

As to the allegation that the parts through which the Swedish and Norwegian Railway runs are *terra nova* from an engineering point of view—whatever this may mean—it may be remarked that the ground over the whole length has been carefully examined and the line surveyed.

As regards the cost of the line, and the allegation that various estimates have been made, none of which can be called trustworthy, the directors are aware of but one estimate, that of their engineers.

As to specific contracts existing between the company and the owners of the mines for a guaranteed minimum traffic, the directors are unable to perceive how it can be alleged that the figures set forth in their prospectus should be received with great caution, as, of course, they are only the outcome of irresponsible "estimators." An allegation of this description is a random and unsupported one, calculated simply to damage the company and having no pretence of justification.

There is no ground for alleging that the line can be worked for only eight months of the year. According to the most reliable information procurable, the fall of snow during the winter is never greater than can easily be dealt with by the ordinary snow plough, and there is therefore nothing to prevent the line from being worked all the year round. This being so, the alleged insufficiency and "dangerous and misleading" nature of the traffic estimate arising from this cause falls, of course, to the ground. As regards the amount of traffic the line is capable of carrying, the writer of the article appears to be astonished at the notion of 5000 tons per diem. But is this impossible on a first-class line of 4ft. 8½in. gauge, such as the Swedish and Norwegian Railway? A total of 600 wagons, representing 552 in running condition, is sufficient to allow of the dispatch of twelve trains daily from Gellivara to Lulea, each train consisting of twenty-three wagons carrying 20 tons each. This gives a total ore transport of 5520 tons daily, and represents the possible traffic between Gellivara and Lulea only, no account being taken of the traffic from Gellivara to Ofoten, which would double the above carrying capacity of the line. Not only are the conditions under which the Swedish and Norwegian Railway will work such as to allow of this being done, but when the fact is remembered that the line can be worked all the year round, the amount of daily traffic required to produce the estimated annual freight of one million tons is greatly reduced, and the erroneous nature of the criticism becomes still more conspicuous.

A considerable parade of figures is made with respect to the percentages of iron contained in the ores examined some years ago by the Swedish authorities; but the conclusion thence suggested respecting the value of the ore from Gellivara, Kirunavara, and Luosavara, is incorrect and misleading. The official examination extended to numerous other sources of ore in the surrounding districts, many of the samples doubtless containing as little as 50 per cent. of pure iron. But at the three places named, to which alone the company's estimates refer, there exists deposits of ore containing 70 per cent. of pure iron, sufficient to supply for centuries to come the utmost traffic requirements of the line.

According to the terms of the concessions, the company have five years more—up to the end of 1891—in which to construct the line; and their engineers estimate that it can be completed in half that time. To characterise the announcement that work at both ends would be continued throughout the winter as misleading, and to assert that the first rails could not be laid before May 3rd this year, and that no work could be begun till May this year, is simply untrue. The works have never once been stopped by reason of the severity of the weather or the hardness of the ground during the winter; the first rails were laid at Lulea before the end of last year; at the end of July this year nineteen miles of the main line—exclusive of sidings—were laid, and it is expected that by the first week of October the permanent way will extend continuously thirty-seven miles from Lulea. It has never been asserted on the part of the company that the darkness, or semi-darkness, which prevails for some three months, will contribute to the easier working of the line; but it is a fact that the absence of the sun is largely compensated by the brightness of the aurora borealis, and that during the winter it is rarely necessary to light the street lamps in Lulea. However, the writer himself effectually disposes of his own statements by saying that he does not for a moment dispute or doubt the possibility of constructing the line, and with this abandonment of his position the objections on the question of time may be dismissed from further consideration.

The writer of the article must be ignorant of the official statistics of population and trade in the districts traversed by the railway, or he would have hesitated before penning the statement about their being inhabited only by a few hundred poor Lapps.

The extension northwards of the Swedish States Railway, destined to join the Swedish and Norwegian Railway at Boden, is steadily in progress, and already open for traffic to a point some forty miles north of Hernosand. A statement appeared in the *Times* of 31st August "that the Finnish States Railway is open up to Uleaberg, a distance of 160 miles from Lulea;" and it may be pointed out that the distance from Lulea to Wasa is not, as stated, 700 miles, but 360 miles only.

To legitimate and fair criticism the directors have no word of objection to offer—nay, they invite such criticism, in the firm conviction that the more the enterprise is examined the more its genuine merits will become apparent. But the natural and unavoidable difficulties attending the carrying out of an undertaking of such magnitude as the Swedish and Norwegian Railway are sufficiently great without artificial aggravation by the publication of statements entirely at variance with the facts of the case. Those statements, deriving a show of *bonâ fides* and authenticity from the fact of appearing in the columns of an influential professional paper, are calculated to mislead public opinion and seriously injure the company; and the directors trust that a full correction—to which they do not doubt the Editor will gladly give insertion—may appear without delay in The Engineer, in at least as prominent a position as the article containing the mis-statements.

Swedish and Norwegian Railway Company, Limited,
Edgar J. Ford, Secretary.
3, Victoria-street, Westminster, S.W., September 25th.

[We willingly insert the foregoing statement of the directors, and we assure them, though it scarcely seems necessary to do so, that we have no wish to injure their line; on the contrary, in common with all interested in engineering, we hope that their anticipations will be fully realised.—Ed. E.]

EQUILIBRIUM OF MASONRY ARCHES.

Sir,—I regret having been prevented answering "F. E. R.'s" letter in your number of August 6th earlier. I have perused Mr. Greene's exhaustive treatise, and with all deference beg to differ with him, for he, after having deduced some very elaborate formulæ for the iron rib, takes these same formulæ and applies them to the masonry arch. Now, iron is a material well calculated to sustain compression, tension, and deflection, and vastly different from masonry, which can only withstand compression and such slight tension as the mortar in the joints will bear. Besides, with an iron rib you have a homogeneous mass to deal with, whereas in the masonry arch each joint in the voussoirs may be looked upon as a hinge, which, when inverted, would be represented by a chain made up of a number of short links, whose length would equal the distance between the joints in the arch. Therefore, the nearest approach we can get as to the curve of equilibrium is by treating it as a funicular polygon. A. S. H.

October 5th.

EFFICIENCY OF CENTRIFUGAL PUMPS.

Sir,—Mr. C. Brown pretends in his letter, which you published in your issue of September 24th, page 245, that the form of the blades in a centrifugal pump materially influences the efficiency of the pump. Certainly it does, but only when the pump is discharging water. Then the form of the blade has about the same influence on efficiency as the breadth or width of the wheel has. I am sorry that Mr. Brown did not mention what sort of wheel he used for his experiments, if of constant or of diminishing breadth towards the outer periphery. But I will for simplicity's sake suppose he used a wheel of constant breadth; that is to say, a wheel the blades of which are between parallel discs. Now the curve of the blade Mr. Brown found best in every respect meets the outer circle at an angle of about 90 deg. Relatively to the revolving wheel, water in a centrifugal pump rushes out of the wheel in the direction of the last element of the blade; with Mr. Brown's blade therefore nearly in a radial direction, and the passage open for outlet is nearly equal to the circumference multiplied by the breadth of the wheel. But the passage open for the entrance of water is equal to the inner circumference multiplied by breadth and multiplied by the sine of the angle at which the last element of the inside of the blade cuts the inner circle. The passage for entrance is therefore considerably smaller, and the relative velocity of the water at the inlet much greater than at the outlet. If the relative velocities are called u_1 for the entrance of water, and u_2 for the water rushing out at the outer periphery, we gain the height of pressure $\frac{u_1^2}{2g} - \frac{u_2^2}{2g}$.

A pump with a wheel of constant breadth and blades of Mr. Brown's design is therefore able to give the same discharge at the same circumferential velocity, but to a higher lift than any other. This advantage disappears of course if there is no discharge at all, and the pump only holding up or balancing a column of water, because then no velocity of the water exists relatively to the wheel. We have then only a revolving body or ring of water, which may hold up at a certain circumferential velocity v a column of water, the height of which cannot exceed the value of $\frac{v^2}{g}\left(1 - \frac{1}{m^2}\right)$, if the inner and outer diameter of the wheel is as 1 and m. The best result one may obtain from a wheel with diameters as 1 in 3, when water is to be held up at a height h without discharge is given by the equation: $v = 0{\cdot}75\sqrt{2\,g\,h}$, whatever may be the form of the blades, and whatever breadth the wheel has.

Vienna, September 30th. Fritz Krauss.

MIXED TRAINS.

Sir,—I think with "C. R. I." that Mr. Stretton may know something about railways, but he is certainly a little mixed in his notions as to mixed trains. My opinion with regard to mixed trains is that the carriages should never be placed next to the engine, that being the most dangerous place in case of accident, but should always be behind the goods, with the guard's van last. This van might be constructed to carry ten or twelve third-class passengers, and should have an elevated seat and look-out to allow the guard to view the whole length of the train. One composite carriage consisting of one first, one second, and two third-class compartments is generally all that is required in a mixed train; if more is required it would pay to run a separate train.

All carriages intended to run with a mixed train should be built with extra strong under framing, and have a moderately short wheel base, short couplings, and the same class of wheels, axles, and springs as the ordinary ten ton goods trucks. Mixed trains should not run more than twenty miles an hour, especially over short up and down gradients such as are usually found on lines where mixed trains are necessary, and should not, if possible to avoid it, be ran with heavy coal trains. I agree with "C. R. I." in thinking that traffic managers know their business quite as well as any officer of the Board of Trade; if they did not, it would be rather a serious thing for railway companies. R. S.

October 6th.

VISITS IN THE PROVINCES.

Sir,—In the report of the British Association's visit to Birmingham, noticed in your impression of September 24th, you were good enough to refer to Piercy and Co.'s Engine Works, and to my reports to the Corporation of Birmingham respecting the compressed-air scheme, and the burning of the town refuse. With regard to the latter, owing to, I presume, a printer's error, the commencement of the article would convey the impression that 50,000 tons of refuse are consumed annually in Birmingham, and that the whole of the excreta collected by the pan system is turned into saleable manure, at a total cost of 4d. per ton. It should, however, read that the consuming of the 50,000 tons of refuse alone costs 4d. per ton, the words "at a total average cost of only 4d. per ton" simply being put in the wrong place. The whole sentence should read as follows:—"Whereby 50,000 tons of such refuse are consumed yearly, at a total average cost of only 4d. per ton, the heat being utilised in firing 650-horse power boilers for reducing to a dry state the excreta collected on the pan system to be used as manure."

I may say that the result of the excreta being treated in this way is that the product therefrom is sold as a very valuable manure at about £6 10s. per ton, which of course could not be produced for 4d. per ton! Perhaps you would be good enough to insert this in your next impression, as the figures quoted may perhaps mislead. Henry J. T. Piercy.

Broad-street Engine Works, Birmingham.

LOCK NUTS.

Sir,—I shall be very glad to be better informed on the above subject, and thank "Lead Pencil" for bringing forward the subject. I have a somewhat fixed opinion of my own, which I am afraid will take some converting to the new-fashioned theory. My idea on the subject I beg leave to give your correspondent in a conversational form, as it occurred some nine years ago with one of the heads of the first engineering works in this country. I was corrected in a similar manner to our friend "Lead Pencil," thinking I was ignorant of the correct (?) theory—which I was not. I was told "that by the screwing on of the 'outside' nut, the 'inner' one had screwed off the thread, thereby transferring the strain to the former, which should therefore be the large nut." To his surprise I agreed with him that such would be the case, but having gone through the same reasons with other engineers, I was again prepared to maintain my position by observing, "in that case, Where is the lock nut? For if the one is screwed off the thread, it is no longer a nut, but a 'distance' piece or 'ferrule,' and its additional surface friction is all that helps the other nut." No wonder then that the outer nut should be the full depth. But, I said, "Why should the 'inner' nut be so dealt with as to screw it off the thread, when it is put on by the same spanner and with the same power as the 'outer' one? Does the putting on of the latter in effect increase the force put on the former and by the same spanner?" His answer was a complete surrender, although he somewhat qualified it, with an apparent desire to leave it an open question, and did not insist upon me altering my "thin nut on the outside."

It has been my experience, Sir, to find that there are not many fitters who know what constitutes a "lock nut." They would say that one nut screwed on top of another is a "lock nut." It may or it may not be. They do not look to the one all-important point, *i.e.*, the "finish," or "break" of the threads in each nut on the surfaces next to each other. If it is directly opposite to one another, they are not "locked," but "open" throughout and constitute one nut; whereas the outer one should go past the finish or break of the thread of the inner one before it can possibly be locked. It was the practice in the shops where the writer served his time to make the threads of the outer or thin nut easier, so that it could be put on the whole way by the finger and thumb, and finally nipped up.

In conclusion, Sir, if the nuts are put on in a common-sense way, there cannot be any more pressure on the outer nut than in the case of a small split pin doing the same duty.

October 1st. J. T. W.

Sir,—I have read in The Engineer of to-day a letter from you correspondent "Lead Pencil" asking for information as to the practice in other shops regarding the position of lock nuts. I believe it is the general practice to place the lock nut outside, *i.e.*, on top of the main nut. As regards our own shops, in which I am now serving my time, I can only say that it is the custom in every case, I think I may say without exception, to put the lock nut outside the main nut, the idea being that the nut nearest the work—contrary to the opinion of "Lead Pencil's" chief draughtsman—stands all the strain, while the lock nut, as the name implies, effectually prevents the main nut from shifting. H. J. L.

West Kensington, October 2nd.

Sir,—I notice in last week's Engineer a letter signed "Lead Pencil," which evidently comes from a young draughtsman who requires to be taught that it is not right or proper to dispute with his chief. In a well organised factory the chiefs of departments are responsible for the work under their care, whether the work be in drawing or in handicraft, and the journeymen who work under them simply do as they are told; or the chiefs, who are responsible for their work, may be led into all sorts of difficulties. It is therefore a great nuisance for a chief to have to contend with a disputing young man such as "Lead Pencil." The chief, of course, was right in stating that in lock nuts the working strain is taken by the top nut, and therefore the top nut should be this deeper of the two.

I find that it is the practice in the large marine shops on the Clyde and in many other places to put the large nut on the top. Theoretically this is right, but in practice it is a nuisance, because the thin nuts are usually so very thin that in being placed underneath they are a bother to be got at with a spanner. I therefore think that in practice the nut makers should make their lock nuts about three-quarters the depth of the other instead of about half the depth. And I believe that the nut maker who first started this practice would reap the benefit in larger sales.

This is rather an important although apparently a small matter to engineers. There are so many hundreds of lock nuts to look after in an ordinary factory that the experience of others would be interesting. A.M.I.C.E.

Gloucester, October 5th.

Sir,—If "Lead Pencil" and his fellow-draughtsmen will consider the question carefully, they will, I think, hold the same opinion as their chief about the relative positions of the thin and thick nuts where used together for locking purposes. If the outside nut of the pair is tightened on its bolt, as it should be, the inside nut will act as a washer on distance piece, the thread in it being almost entirely relieved from pressure. It necessarily follows that the thick nut should be outside. A. E. C.

October 5th.

LOCOMOTIVE TAIL RODS.

Sir,—In a copy of your valued newspaper for September 3rd, on page 189, there is a paragraph calling attention to certain locomotives now said to be under construction in the Grand Trunk shops at Hamilton, Ontario. The writer of this paragraph professes to a great deal of knowledge on the subject of tail rods, and assumes that locomotive superintendents in the United States are very ignorant. On this point I have nothing to say, but if his knowledge of tail rods does not exceed his knowledge of geography, I should think the locomotive superintendents of the United States need not care much for his criticisms.

You might let him know that Hamilton, Ontario, is not in the United States, and that the locomotive superintendent whose work he is criticising is an Englishman, with strong English proclivities, who served his apprenticeship in his native country.

Montreal, September 20th. Chowbent.

WIND PRESSURES.

Sir,—In reference to Mr. F. A. Campbell's paper on "Wind Pressures" in your issue of the 1st, I would beg to correct his statement as to maximum wind pressure in England. This was recorded at the Bidston Observatory on the 9th March, 1871, and amounted to 90 lb. per square foot. I have proved pressures of 55 lb. and 57 lb. by an anemometer of my own construction, at an elevated spot in Liverpool, on the dates of 12th December, 1883, and 26th January, 1884, respectively, when the corresponding Bidston pressures were 71 lb. and 70 lb.

Henry A. Dibbin, M. Inst. C.E.

Albion Villa, Roby, Liverpool, October 2nd.

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PUBLISHER'S NOTICE.

*** *With this week's number is issued as a Supplement, a Two-Page Engraving of an Express Engine for the North British Railway. Every copy as issued by the Publisher contains this Supplement, and subscribers are requested to notify the fact should they not receive it.*

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TO CORRESPONDENTS.

Registered Telegraphic Address—"ENGINEER NEWSPAPER, LONDON."

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J. K. S.—*A letter awaits the application of this correspondent.*

Tay Bridge.—*The engine was got up very little the worse, and is now working on the North British Railway.*

F. H. H. (Leek).—*Certainly. Every particle of the flange below the rail level is moving in a direction opposite to that of the train. Why do you not think such questions out for yourself?*

"Englan and Auld Scotia."—*A letter would, perhaps, have made this correspondent's intended communication more comprehensible than is possible on the limits of a post-card, but we will take note of what appears to be his leading idea.*

LUCOP'S PULVERISERS.

(*To the Editor of The Engineer.*)

Sir,—Can any of your readers tell me where I can obtain information about these? Joggleworthy.

London, October 7th.

PEN-MAKING MACHINERY.

(*To the Editor of The Engineer.*)

Sir,—Can any of your readers give me the address of the makers of pen-making machinery? Pennah.

SHOT POLISHING MACHINES.

(*To the Editor of The Engineer.*)

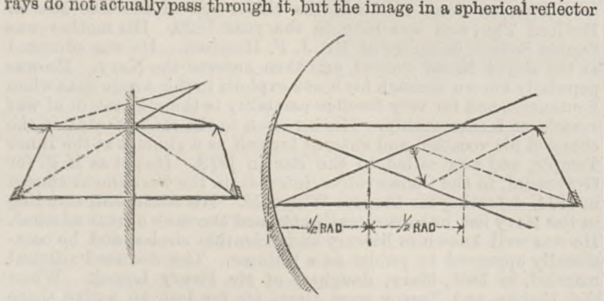
Sir,—I should feel obliged to any reader who could get me some addresses of makers of machines for polishing and separating lead shot after it has passed in the ordinary way through sieves. H. L. M.

Birmingham, September 30th.

AN OPTICAL PROBLEM.

(*To the Editor of The Engineer.*)

Sir,—The beneath figures give constructions for images in plane and spherical reflectors. The image in a plane reflector is virtual, *i.e.*, the rays do not actually pass through it, but the image in a spherical reflector



is real, *i.e.*, formed by the actual intersections of the rays. "Lux" does not mention if the image was inverted or not. The subject is elucidated very well in Professor Everitt's "Dechanel," § 710, &c., which "Lux" had better consult. E. A. Hackett.

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MEETINGS NEXT WEEK.

North-East Coast Institution of Engineers and Shipbuilders.—The annual general meeting will be held in the Lecture Hall of the Literary and Philosophical Society, Newcastle-upon-Tyne, on Wednesday, October 13th, at 7.45 p.m., when the Council will submit its report for last session, and the President, Mr. W. T. Doxford, will deliver his inaugural address.

THE ENGINEER.

OCTOBER 8, 1886.

INERTIA OF MANUFACTURERS.

The altered conditions under which manufacturing trades are carried on in England now, as compared with a quarter of a century ago, do not seem to be yet as fully or generally realised as it is necessary that they should be if one of the chief causes of depression is to be removed. The age of mechanics has robbed England of the unique position she held as the workshop of the world. England now holds only the position of the greatest manufacturer with the oldest and widest connection. Now and then, when the fluctuating race between demand and means of supply result in the lowering of prices until the race is less unequal, this as a fact is forcibly placed before our manufacturers; but in many cases the lesson is soon forgotten, and every time with loss to the country. When demand strains the means of supply and trade is said to be good, new capital is invested to obtain those means and to enter a profitable trade. In this age of mechanical progress it seldom happens that the capital so invested fails to secure plant which is some improvement of that of the older establishments in the same trade, and each periodic fluctuation tends to leave the older establishments a step behind. This is proved as soon as the race is again won by the means of supply. Then it is that those manufacturers whose inertia is great, rapidly experience depression in trade and low prices. The more enterprising manufacturers, those whose inertia is not great enough to prevent their overhauling their establishments, the investigation of their methods of production, possible means of reducing cost, and careful consideration of new methods with enterprising spirit, these feel the depression last or not at all. We frequently have strong proofs of the fatal results to a business of a disinclination to look into new proposals, machines, or processes. While nothing is more fatal to an established concern than a restless desire for change merely for change, many businesses have been lost, and some languishing now, in consequence of refusal or inability to see the value of improvement in method or design, even though it may be improvement in a thing that gives general satisfaction. The improvements or novelties which are always turning up, or the desirability of which are always becoming apparent, will certainly be made, and be adopted by somebody at home or abroad, and if the latter, so much the worse for English manufacturers. This is true of manufactures, from the small and almost frivolous, to steam engines and bridges. Of the smaller things, a very good example is seen in the following extract from a trade letter:—"The Staffordshire brass cabinet lock manufacturers have for some time experienced severe German competition in common goods in the London market. By the adoption of steam power and otherwise cheapened production, however, several Wolverhampton firms are now winning back the trade. Yesterday it was announced that they are meeting with increased success. It was some time before the workmen could be induced to make on the German lines, but now the imported goods are being imitated in design and finish, and offered at lower prices. Makers express every confidence in further recovering lost ground." Here is a case of an old-established English trade being beaten by means which the manufacturers themselves might, but for their inertia, have themselves possessed. After losing trade and market they adopt the machinery which in greater or less extent they might have had some years ago. After losing money by loss of trade, they spend the money on the improved means of production, and have to spend more to get back their markets. During the time that they were, to their discredit, being beaten by the Germans, they no doubt complained loudly of trade depression. Even now they only claim to imitate in design and finish the foreign article, though at a lower price. To be able to make at the lower price is to their credit, but it is not to their credit that they are satisfied to imitate either design or finish. Our people must go on, and must not shelter themselves by saying they cannot get men to work on the new lines. Judicious action with firmness will always get over the inertia of the workmen, just as Messrs. Tangye, for instance, managed some time ago when a change became necessary in a large part of their works, and if no other way can be found of getting the men to act wisely, then let the manufacturers take a leaf out of Mr. E. H. Bentall's book.

We have on previous occasions spoken of the loss to Britain which results from inertia amongst our bridge builders. Some of this is due to the out-of-date regulations of our Board of Trade; but so far has the British bridge-building trade become wedded to old methods of manufacture and terms of business, that American and Canadian bridges are now being bought by English civil engineers for railways in course of construction, though not in either of those countries; but we need not say in which. The orders are going to those countries because really satisfactory bridges can be obtained to carry a given load, and with a guarantee for ten years, for a sum which is not more than 60 per cent. of the price demanded by English builders. The American and Canadian bridges are well-designed, pin structures, in every way satisfying the engineers of the railway; and the builders' price is for the bridges placed upon the piers and finished, the engineers having very little more trouble in the matter than to order them and test them; while for bridges for the same places, if ordered in England, the engineers would have to provide designs and specifications, follow the structures throughout their whole history to completion, and then pay about 40 per cent. more for them. In railway matters, again, the transatlantic constructors will provide rolling stock for prices and terms which afford facilities that probably not more than one English firm give.

In many ironworks in England there are yet at work antiquated engines, machinery, and tools which for sake of economy should have been on the scrap heap long since. Where this sort of thing exists trade is bad. On the other hand numerous engineering works in this country can be pointed to that have been well provided with work throughout the whole period of depression. In these works money has been spent in order to make more by means of good tools properly worked, and by making machinery of new and improved design and construction, produced at as low a price as those of poor or ordinary designs in less energetically conducted works. In these days it does not pay for any length of time to try to make purchasers suit their requirements or wishes to the manufacturers, the latter must make what the purchaser prefers. No manufacturer can afford to continue to make a given machine of the same pattern as that he made ten years ago. He must improve it wherever possible, or another manufacturer at home or abroad will do it for him, and save him the trouble after awhile of making any.

SOURCES OF POWER.

In the older treatises on mechanics we find the sources of power classified under the heads "Wind, Water, Steam, Animals;" and, broadly speaking, these are still the only sources of power we possess. But when we deal more in detail with the subject, we find that wind in all probability owes its capacity for performing work to the sun, while water is absolutely inert save as actuated by gravity, and steam is of course merely an agent by which heat is converted into work. Concerning the methods by which animals perform work, we are entirely ignorant, no physiologist having as yet succeeded in tracing the sequence of processes by which food is converted into mechanical energy. Enough is known, however, to show that the process has nothing in common with that by which work is performed by heat engines. So that the analogy sometimes drawn between a man and a machine must be rejected as far-fetched, permissible to the poet, indeed, but not to the philosopher. Furthermore, it is known that the work got out of food by men and animals is much greater on the whole than can be obtained from fuel consumed in the best steam engines. That is to say, a man or a horse may be more economical sources of energy, in one sense, than any machine. Be this as it may, it is sufficiently evident that we depend for the performance of all the work done in the world on two main sources of power—heat and vital energy. The action of gravity, it is true, causes the falling of water, and so gives out power; but the water has to be raised before it can fall, and this raising is effected by the heat of the sun, which evaporates moisture and so indirectly gives us clouds and rain.

It appears to be not unreasonable that men should ask themselves now and then if there are no other sources from which power may be derived—is there no other force of nature that can be made the slave of man? The question has been put in hundreds of ways, and remains unanswered. The seekers after motive power have been nearly as numerous and persistent as those who wasted their lives in search of the philosopher's stone. With the "perpetual motion" man we have no patience, and it is perhaps scarcely necessary to point out to our readers that we are about to speak of something very different indeed from the ordinary notion of perpetual motion. Inventors who have sought that have, for the most part, attempted to get something out of nothing; that is, in a word, create energy. There is a wide difference, however—a great gulf, indeed—between this and an attempt to still further explore nature's secrets in search of a source of energy—that is to say, of work—now unavailable. Now, in dealing with this question of sources of energy, it seems to be not impossible that a misapprehension of the nature and bearing of the laws of the conservation of energy may do a great deal of harm. It may be said, for example, that it is quite useless to search for a source of energy which can be better or more economical than what we have now, and much more to the same effect. But let us ask ourselves what is this law of the conservation of energy, on what is it based, and what would be the consequences to the universe if it did not exist? Such questions are very seldom asked, because the number of men who are at the pains to think for themselves is small. But when they are asked, the answer is remarkable. There is really no reason at all why energy should be conserved, and so far as our senses supply evidence, far from being conserved it is being profusely wasted every day. Of course, if we go a little behind the evidence of our senses, we find that the waste is only apparent, not real. It is much easier, however, to form an idea of a universe in which the law of the conservation of energy has no existence, than it is to realise a fourth dimension in space, or even the life of the inhabitants of Flatland. As a help to the realisation of such a universe, we may point to the fact that the sun has been giving out energy for millions of years, and that there is no reason whatever to think that he has lost any portion of his original heat. In other words, it is simply impossible to prove that what we call energy is not created in the sun. Again, let us take gravity. We have here the most stupendous force in nature. There is no reason to imagine that it is capable of degradation. If all the planets fell into the sun, gravity would of necessity have performed an enormous amount of work; but no one can say that after it was done gravity would be any the weaker. It may indeed be said that the law of the conservation of energy has only just missed being disproved, if the words "conservation of energy" be used in one sense. So far as can be seen there is no reason why the line of magnetic force should not behave like lines of electrical force or heat force, and admit of being intercepted or stopped. It would then suffice to put a permanent magnet under one end of a beam, the other end of which should be connected in the usual way with a crank and fly-wheel. Then, by interposing and withdrawing a thin intercepting plate at the proper intervals, we should have a machine which would work steadily until it was worn out, without the expenditure of one farthing for fuel. In the popular sense of the word, we should create power; and the perpetual motion men would spend their lives in patenting details, while the principle would be public property. Has any one the least idea why magnetic force lines should traverse every known material? Can any one assert that if this was not the case the existence of the universe would be impossible or even difficult? Can any one assert with certainty that no means will ever be found for intercepting or dissipating magnetic rays, without expending energy in doing so? Finally, is it not possible to obtain some idea of the cause of magnetic force from this very peculiarity of its behaviour? To put an extreme case, it may be urged that the law of the conservation of energy being true, it is impossible to intercept a magnetic force line. What, then, is the nature of the force which will comply with this condition? On the other hand, it is possible to intercept a heat, light, or electrical line, and yet the law of the conservation of energy is not interfered with—*ergo*, magnetic force must possess features which distinguish it from the other forces we have named; from all other forces, indeed, save gravity. One deduction seems to be consistent with facts—namely, that magnetism and gravity are original or primal forces, and that the remaining forces—such as light, heat, and electricity—are derived, built-up, or composite forces. That, in a word, gravity and magnetism are elements, while light, heat, and electricity are compounds. We speak of light, heat, and electricity as "forces;" perhaps it would be more strictly correct to speak of them as manifestations of force. But what we have written will serve sufficiently well to convey our meaning.

The sum and substance of what we desire to convey is that there is nothing known which renders it absolutely certain that mankind may not yet find new sources of energy in nature. No one can assert positively that it must always be impossible to make electricity work for us. If a man had shown Socrates a lump of coal, and told him that it could be converted into work, he would have laughed at him. Our purpose will be served in writing this article if we make our readers understand that there is as yet at least no finality in science. There is no reason, for example, to conclude that it is absolutely and physically impossible that sources of power may yet be discovered which are not now dreamed of. The electricity which now rends the forest oak, or brings down the lofty edifice in a hideous ruin may yet be taught to light our towns. Chemical science may give us new reactions which will supply large sources of power. The world does not yet know everything; and he who knows most is least likely to assert dogmatically that things which do not exist now never can exist in time to come.

TECHNICAL SCHOOLS IN THE UNITED STATES.

Technical education is a subject which each year attracts an increasing amount of attention from the thinkers of all civilised countries. In former times the length of the sword and the efficiency of the army—in other words, the fighting powers of a nation—formed the chief means of maintaining and increasing its material wealth. They still continue to constitute an important factor in the well-being of nationalities. They happily, however, no longer stand alone. In this, modern thought shows that the arts of industry pursued in peace contribute more to the well-being of peoples than the art of war. If properly considered the chief function of the latter will be found to consist in protecting the former, and any nation or Government regarding it in any other way—using it, in fact, for wanton aggression —usually impoverishes itself thereby. We venture to assert that, other things being equal, the best technically educated nation must eventually become the wealthiest and the most powerful. The lessons taught by Archimedes at the seige of Syracuse hold good to this day. Our American cousins show year after year that they are alive to this, and are extending and developing technical education. An interesting paper on "Technical Training at the Worcester Free Institute," was read before the American Society of Mechanical Engineers last year, and well discussed. Its author, Mr. George J. Alden, of Worcester, Mass., refers first to the origin of the Institute, opened seventeen years ago, and then to its course of study and practice, illustrated by means of a chart showing the amount and distribution of the time devoted by the student to each study. The chart includes a scale diagram showing graphically the relative time assigned in the whole course to each branch or department. This is followed by diagram analyses of the several departments, showing the course more in detail. Finally, Mr. Alden gives an explanatory reference to special features of the school training. The paper begins by explaining that the term "free" applies only to students resident in Worcester County, in which the school is situated. Students from other localities pay tuition fees at the rate of 150 dollars per annum. The full official title of the foundation is the "Worcester County Free Institute of Industrial Science," and Mr. Alden dealt with it especially in its relation to the training of mechanical engineers. The problem which the administrators of the school addressed themselves to solve was how best to combine theoretical with practical instruction. Mr. Alden tells his readers "that the first dreams of the possibility of such an institute were entertained by men who were unfamiliar with schools either of science or of any other department of higher learning. John Boynton desired to give 100,000 dols. to found a school free to the youth of Worcester County, where studies could be pursued which were not usually taught in the public schools, and which would fit them for the practical duties of life."

In the Worcester Institute the working hours are from fifty-nine to sixty-eight per week, but this is not nearly all close mental or study work. Ten hours a week are given to practical work in the machine shop. From six to ten hours per week are devoted to drawing, and several hours to laboratory practice, so that the time given to purely mental labour is reduced to five or six hours per day. We learn from Mr. Alden's paper, that of the 2376 hours of practice, 800 hours are made in the apprentice half-year preceding the regular school course of three years, and 336 hours is summer practice made outside of term time, leaving but 1240 hours which are taken up by practice in regular term time. This is much less than the time given to the study of mathematics or language during the same period, and only one-sixth of the student's working time during the term.

Of course Mr. Alden gives a synopsis of the various branches of study at the Institute, and they cover a wide field. They are much the same as those of the best technical schools in this country. If there is any fault about the curriculum it is that it embraces too many subjects. They are nine in number, and of these that of practice or work in the shops includes instruction in all the departments save and except, strangely enough, the blacksmith's forge and boiler making. One of the chief points discussed in connection with the paper was whether it was best or the reverse to attempt to combine the practice section partly or wholly with theoretical instruction. The contention on both sides is pretty much such as we have known in this country, and which may be thus epitomised. No mechanical engineer deserving to be so called can ever expect to attain eminence if he is unacquainted with the practical conditions attending the embodiment of paper designs in the shops. With this contention every sensible person must agree. Against practical work in school is urged its tendency to degrade. Extending this a little, the advocates of practical training in technical schools truthfully observe that it is impossible to judge exactly the mental bent of any pupil till developed by training, and thus for at least the first two years of the course it is better to teach both theory and practice; by the end of that time a judgment can be formed as to which branch the pupil is best suited for, and that should be given the leading place in his remaining studies. If those sentimental folk who regard practical work as degrading would but think a little, they could not fail, if possessed of any intelligence, to see that practical training will, and indeed must, assist theoretical studies. Does not practical instruction, as imparted at bedsides, in the operating theatre, and in the dissecting rooms of hospitals form a leading and absolutely essential part of the education of physicians and surgeons? Are engineering students to be regarded as such heaven-born geniuses that books and drawings-boards are alone needed for their instruction in dealing with the mightiest forces of nature; or to qualify them to design and superintend the construction and working of machines, on whose soundness and efficiency multitudes of human lives may depend? Would the passengers in an express train feel especially comfortable if told that the engine drawing them and the track over which they were moving had respectively been made by men who never got any but theoretical teaching—mere paper engineers? The advocates of practical training are themselves divided in their views—one party contending that it ought to progress contemporaneously with theoretical tuition; the other averring that no really efficient practical instruction can be obtained outside regular engineering shops, where everything is done with the view of making profitable work. Put in another way, they assert that students in technical mixed schools cannot be taught how to produce at the lowest cost. From this we must dissent. As technical schools are now carried on, it may be that "reducing cost of production" is not in their curriculum; but that it cannot be included remains to be proved. We are of opinion ourselves that no technical school dealing with constructive matters can get along without some sort of means of practical illustration; nor, to do them justice, do they try. As yet, however, the idea of making the practice shops of schools money-producing undertakings has been tried without success.

We cannot, from lack of space, attempt even to superficially review all the matter contained in the paper under notice or the discussion thereon, but we recommend all who are interested in technical education to peruse it. We can only add now that we believe the time is approaching, if, indeed, it has not already arrived, when a regular codification of the systems of teaching the higher or professional, as well as the working branches of mechanical engineering, must be effected, and some such method as that suggested in the discussion by Professor Webb be adopted. He said: "There are really three kinds of schools which at the Philadelphia meeting of the American Association I suggested, and which were likewise simultaneously proposed by General Walker at the Social Science Association. First, a school of mechanical engineering, where the object is to produce the engineer, who must know all the higher parts of the business. Next, we have the school for superintendents, who must be able to direct and control the workmen, and must know intimately all the processes; he does not need to know the higher parts, for which he can depend upon the engineer. Lastly, we have a third kind of school, which is for the younger students who have not yet chosen their business or profession, and the majority of whom will never engage in mechanical pursuits; in fact, for all boys who are in public schools. This is called the manual training school."

We cannot better conclude this article than by pointing out the truth of the contention of those who advocate, as is done above, the prudence of giving the aspirant to an engineering career a preliminary and test training to ascertain his real fitness for it. We are sure that many engineers in this country, both civil and mechanical, could testify to pupils of their own who, after years of apprenticeship and much expenditure of time and money, gave up the profession and adopted some other career. They had at first mistaken their vocation, and when this occurs the sooner it can be found out the better.

MINERS' WAGES IN YORKSHIRE.

Though the Yorkshire coalfield has been pleasantly free for some time from strikes and lock-outs, on an extensive scale, it has been felt that the danger still existed, and now and again in isolated cases recourse was had to the old baneful practices. To avert the peril, once for all, a vigorous effort was made to effect an arrangement by which wages should rise and fall according to the fluctuations in the values of coal. A committee of the South Yorkshire Coalowners' Association has met deputations of the miners, and it seemed almost certain that an amicable agreement would be come to. Unfortunately the negotiations begun in December of 1885 have terminated in October of 1886 in what appears to be a collapse. From the correspondence between Mr. F. Parker Rhodes and Mr. Benjamin Pickard, M.P. —pervaded, it is evident, by a regrettable tone of asperity— there is not much hope of the dropped thread being picked up again for some considerable time. The rock on which the scheme has wrecked is the old one of "standard." The miners wanted the then rate of wages to be considered the minimum, and the appointment of a Board of Conciliation to whom further questions should be referred. The coalmasters considered that no scheme could be made to work satisfactorily unless accompanied by a fair and equitable sliding scale. They also objected to the then rate of wages being accepted as the minimum rate payable under the scheme. On these points of difference the representatives of the two parties engaged in a very long controversy, in which each party charges the other with being responsible for the stoppage of the negotiations. What the public are more concerned about is this, that the first turn of prosperity may tempt the mines' officials to seek higher wages, which, resisted by the coalmasters, would involve the district in the old trouble, with all its attendant loss and suffering.

THE CABLE TRAMWAY IN BIRMINGHAM.

The cable tramway in Birmingham, which is exciting great interest, is about to be commenced from the designs of Mr. E. Pritchard, C.E., and Mr. Joseph Kincaid, C.E., of London, engineer to the Central Tramways Company. There will be two miles and five furlongs of single line, the cost of constructing which is estimated at from £23,000 to £25,000, or about £9500 per mile. The line first to be commenced will extend from Colmore-row to the borough boundary in Hockley. It is to be laid upon a 3ft. 6in. gauge, corresponding with that of the newer tramways throughout the town. For driving it there will be provided at the company's premises in Whitmore-street, Hockley, two engines of 300-horse power each. These, however, will suffice to work another circuit of cable. The aid of electricity will be invoked to apprise the engineer of the breakage of any of the strands of the cable, so that he may know when to expect the damaged portion to pass through the engine-house. It is hoped that the line will be ready for opening by May. It will, it is intended, be a marked improvement upon the cable tramway on Highgate-hill, from which it will differ in a number of particulars.

BUENOS AYRES AND ENSENADE PORT RAILWAY BRIDGE OVER THE RIACHUELO.

The engravings on p. 286 illustrate a fine bridge constructed from the designs of Mr. Edward Woods, President Inst. C.E., to carry the Buenos Ayres and Ensenade Port Railway over the Riachuelo at Barraccas. The ironwork has been made by the Horseley Company, at Tipton, and of it we shall give further engravings and description in another impression.

PETERSFIELD SEWERAGE AND WATERWORKS.

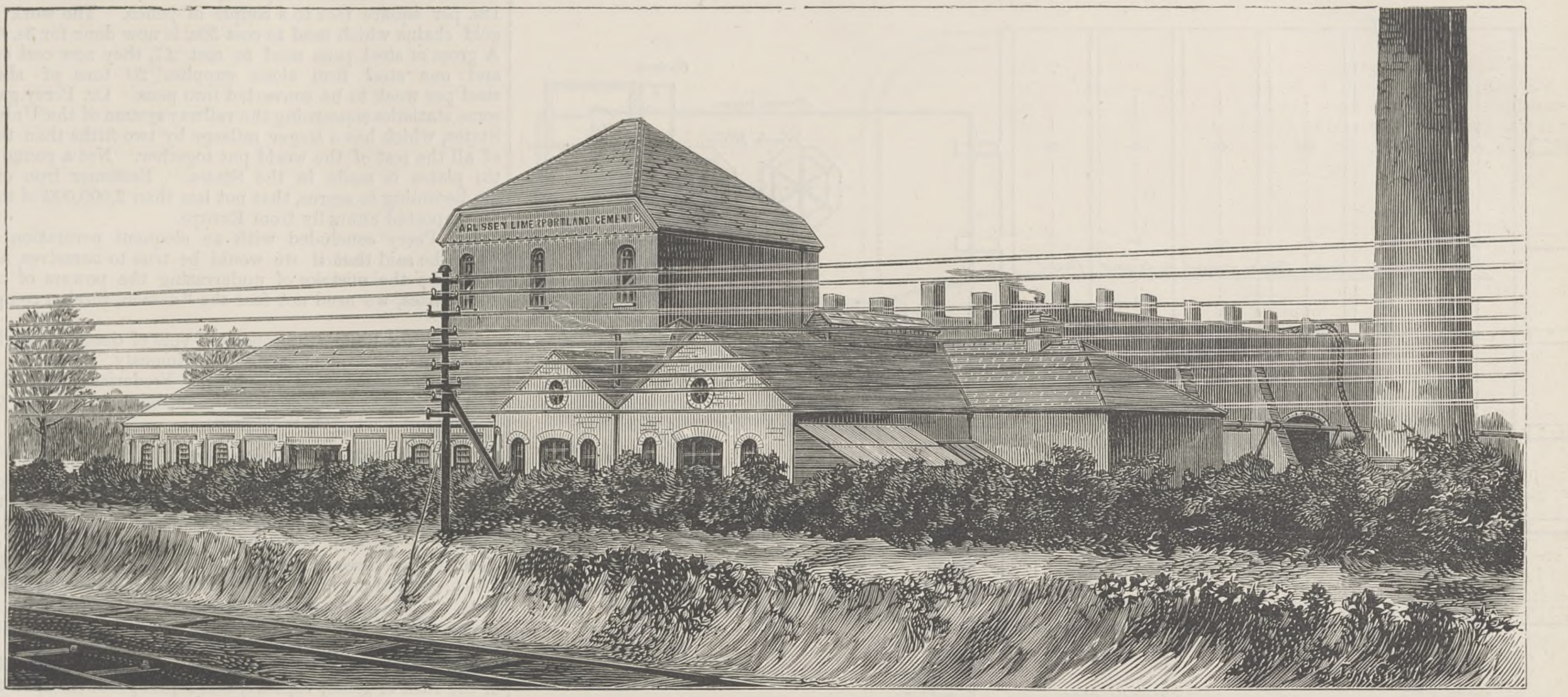
On page 287 we publish engravings illustrative of part of the new waterworks of Petersfield, from the designs of Mr. Henry Robinson, M. Inst. C.E., Westminster. Other engravings and description will follow in another impression.

The Navies of Great Britain, France, Italy, Germany, and Russia.—The late Director of Naval Construction, Sir Nathaniel Barnaby, has prepared a sheet of diagrams, bringing clearly before the eye the salient features of the superior portions of the fleets of five European Powers, with a view of assisting the public to form a judgment on difficult technical questions of great national moment. The diagrams are now in the press, and will shortly be published by E. Marlborough and Co., 51, Old Bailey.

Bedford Pim.—The death is announced of Rear-Admiral Bedford Pim, at Deal. He was the eldest son of the late Mr. E. Bedford Pim, and was born in the year 1826. His mother was Sophia Soltau, daughter of Mr. J. F. Harrison. He was educated at the Royal Naval School, and then entered the Navy. He was popularly known through his brave exploits in the Arctic Seas when lieutenant, and for very forcible partiality to the old system of war vessels and seamanship. Having risen to the rank of captain, he changed his vocation and entered himself as a student at the Inner Temple, and was called to the Bar in 1873. He sat as M.P. for Gravesend, in the Conservative interest, in the Parliament chosen in 1874, defeating Sir Charles Wingfield. His name still standing in the Navy list, he subsequently obtained the rank of rear-admiral. He was well known in literary and scientific circles, and he occasionally appeared in public as a lecturer. The deceased admiral married, in 1861, Mary, daughter of Mr. Henry Locock. When the Erebus and Terror were given up for lost, an active share was taken by Lieutenant Pim in the search expeditions, and it was he who virtually accomplished the North-West Passage, by passing from the vessels which had entered the Arctic regions from the Atlantic, to that of Maclure, who had penetrated from the Pacific. He did excellent service at the Peiho Forts, as a little earlier he did with his gun-boat at the bombardment of Sweaborg, where also he was wounded. Admiral Pim was a boisterously English partisan. He was, indeed, one of the last of the Old Guard. The *Standard* observes of him that, "though latterly reconciled to steam, he, like Admiral Rous, never failed to look back on the decay of three-deckers as a sign of the decadence of the Navy. Foreigners in merchant ships, Free Trade, dandy officers on the quarter-decks, luxuries such as preserved meats, and other new-fangled notions, had the hearty contempt of the sturdy old tar, who had begun life on board a merchant ship, and regarded the British seaman as best reared on salt junk, pea soup, his regular lime juice, and a liberal allowance of rope's end to teach him his duty."

THE ARLESEY PORTLAND CEMENT WORKS.

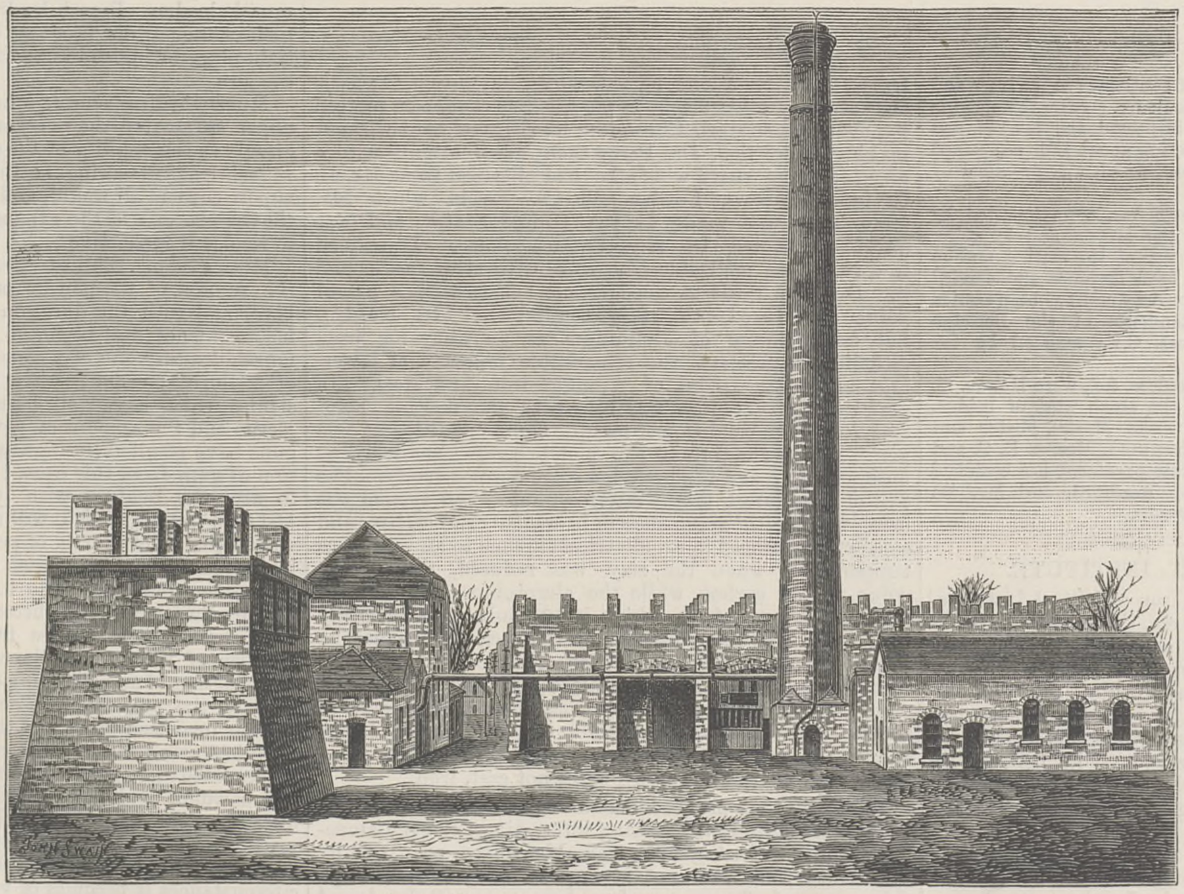
THE PULSOMETER ENGINEERING COMPANY, ENGINEERS.



VIEW FROM GREAT NORTHERN RAILWAY. (*See Plan, page* 292.)

NEW PORTLAND CEMENT WORKS AT ARLESEY.

The above illustrations show the side nearest to the Great Northern Railway of the Portland Cement Works recently erected at Arlesey Siding, Great Northern Railway, by the Arlesey Lime and Portland Cement Company, and the smaller engraving shows the opposite side. A plan of the works is given on p. 292. The whole of the building, machinery, &c., were designed by the Pulsometer Engineering Company, which has also manufactured and supplied the machinery. The works are now turning out Portland cement of the highest quality. The machinery already erected consists of two similar horizontal condensing engines 20in. diameter of cylinder by 36in. stroke, running at 60 revolutions per minute, fitted with variable expansion gear, and each capable of indicating from 93 to 180-horse-power. One of these is used for driving (1) the slurry mills, each 18ft. diameter; (2) the slurry wheel 18ft. diameter, for raising the slurry which is driven at slow speed by new differential gear; (3) a set of special rolls through which all the cement slurry is passed; (4) the mixer, a new machine for incorporating the slurry; (5) slurry plunger pumps, 10in. diameter by 16in. stroke, which raise the slurry, after it has passed through mills, rolls, and mixer, to the top of the kilns; the second engine actuates (1) a specially designed crusher which reduces the cement clinkers to pieces about ⅜in. cube, so as to diminish the work performed by the stones; (2) the mills, which are of the Pulsometer Engineering Company's self-contained pattern — already illustrated in The Engineer. A single Lancashire boiler 7ft. by 28ft.—steel—working at a pressure of 80 lb., furnishes steam for the whole installation. It is fed by a Deane steam pump 5¼in. by 3¾in. by 10in. stroke. Special interest attaches to these works, costly and fruitless attempts having been made in times past to manufacture Portland Cement from materials on the estate. This is, we believe, the only locality near London in which gault clay and chalk are found together. Careful analyses made by Mr. G. M. R. Layton, the managing director, proved that these materials were capable of being manufactured into cement of high quality, and the subjoined tests will show that with care and judgment no materials can be more beneficially employed for the purpose. Average breaking strain after seven days of 100 briquettes of 1½in. by 1½in. by Adie's machine, 1020·42 lb. Average of 50 1in. briquettes, 398 lb. The cement is already in far greater demand than can be supplied by the present kiln power, and additional kilns, patented by Mr. Layton, are now being erected. The result of the substitution of the special rolls and mixer for the ordinary wet stones has been highly satisfactory. The arrangements are specially made with a view to saving labour, and the progress of the material in the cheapest way direct through the works.



VIEW FROM KILNS AND ENGINE HOUSE SIDE.

NEW CATTLE MARKET, NOTTINGHAM.

This town has suffered very considerable inconvenience and annoyance in consequence of the position of the old cattle-market. It was situated in the very heart of the town and distant at least a mile from any railway station, and all cattle therefore brought in by railway had to be driven through the principal streets of the town in order to reach the market. About two years ago the Town Council decided to build new Police and Magistrates' Courts, and the site chosen was a portion of the old market referred to above. This therefore necessitated the removal of the market, and it was decided to lay out a new one on a site at the southern end of the town closely adjoining the Midland Railway Company's main line. It has an area of upwards of seven acres, and is situated about 300 yards from the main public road; between the market and this public road there intervenes a canal belonging to the Great Northern Railway Company; this was crossed by means of a bridge 60ft. wide. It was constructed of wrought iron girders, with facia, cornice, and parapet of cast iron; the flooring of the bridge is of wrought buckled plates, with Portland cement concrete thereon to receive surface paving. The market has two entrances, and the approach road referred to is 60ft. wide, and is divided for "in" and "out" traffic. It contains very extensive accommodation, and the whole of the pens and stalls are of iron. The pigs and calves will be accommodated in a covered building about 140ft. long and 48ft. wide; the building is lighted from the roof and the walls are lined with white glazed bricks to a height of about 6ft. above floor level. Lairs for beasts are also provided where they can remain for a day or two prior to or after the large market which is held on Wednesdays. The arrangements for the sale of beast by auction are very complete, and have been carefully planned; there are stands for six auctioneers, the largest containing accommodation for the sale of about 250 beast. The unloading platform is 410ft. long and 45ft. wide, and contains numerous pens or docks into which the cattle are collected before being driven into the market; the sidings adjoining the platform are in direct communication with the Midland, the Great Northern, and the London and North-western companies' lines. On the platform are railway companies' offices, and also a room for the drovers to shelter in while awaiting the arrival of cattle. The cattle stalls and auctioneers' stands will acccommodate about 1100 beast, besides the accommodation provided in covered lairs. The sheep pens, 180 in number, will accommodate 2500 sheep, and there is a space provided under cover for about 450 pigs and calves in 47 pens. The market is so arranged and planned that the accommodation can be doubled at a comparatively small outlay, as the whole of the main roads and approaches are laid out in view of an immediate extension being required. The offices and refreshment rooms are in two blocks; the former block contains offices for auctioneers, a public room for the settlement of accounts, and also a bank; the latter block contains a refreshment room 50ft. by 18ft., also one of smaller dimensions, a dining room, kitchen, and other appurtenances. The horse fair and hay and straw market will be held on a piece of ground adjoining the main entrance road, and has an area of about 1½ acres. Two weighing machines have been provided, one for weighing hay and straw, the other for weighing cattle. The drainage is thoroughly efficient, the pipes used were Hassall's patent pipes, and the upper end of each length of drain is supplied with a tank which is fitted with one of Field's automatic flushing syphons; the market is lighted with gas, and water is laid on to numerous hydrants in all the various blocks of pens and stalls.

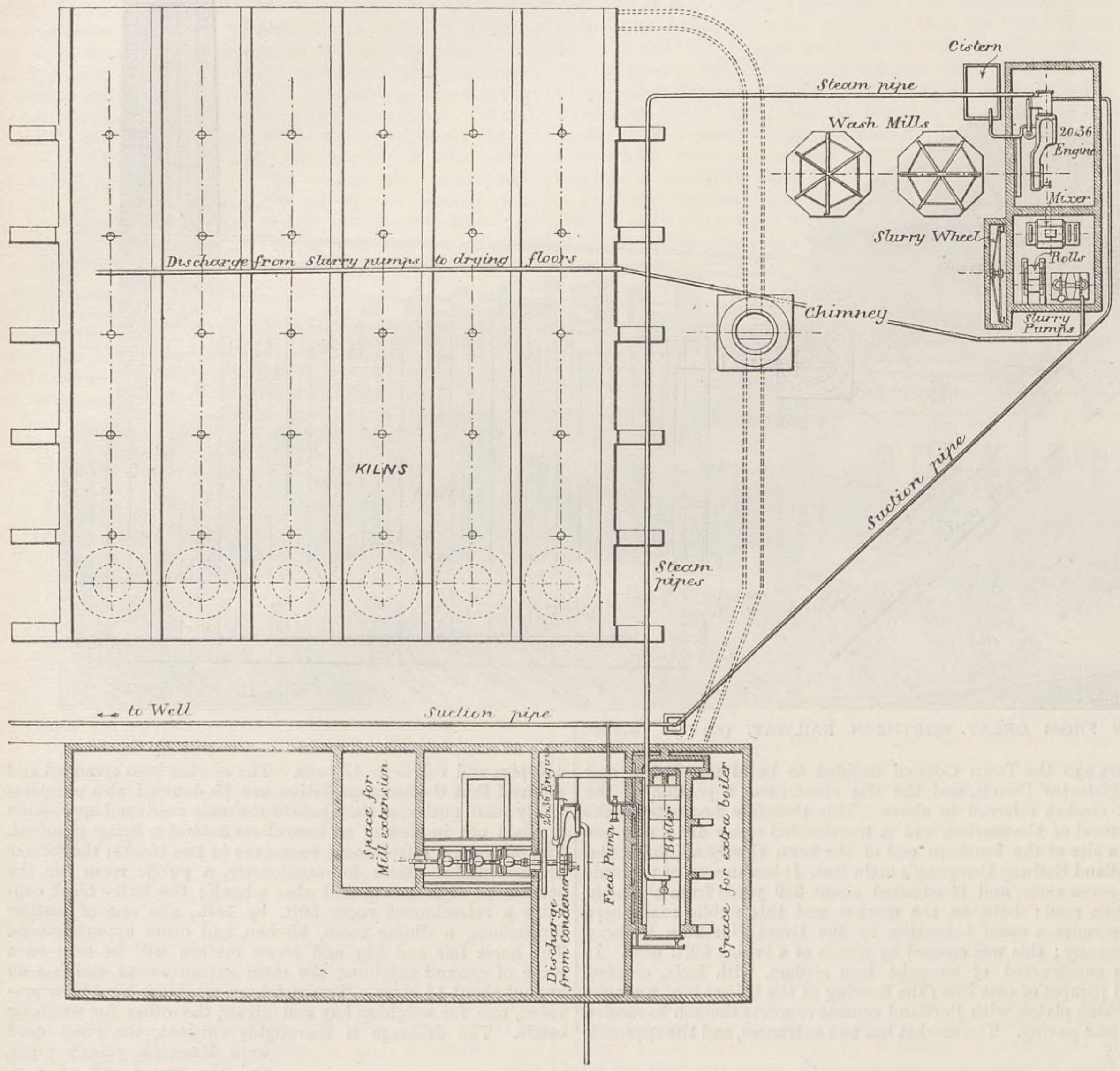
One of the most important features in the market is the paving; the whole of the pens, stalls, lairs, unloading platform, and also the subsidiary roads, which are 30ft. wide, are laid with Portland cement concrete composed of finely broken granite and cement in the proportion of two of the former to one of the latter. All the cement used for the work was tested and had to stand at least 400 lb. on a briquette an inch square, or was rejected; the concrete for the roads was 3in. thick, the remainder was 2½in. thick, and the whole of it was laid on a foundation of Portland cement concrete about 6in. thick. The surface of concrete paving was grooved, except in sheep and pig pens, so as to give increased foothold, and the area of the concrete pavement altogether is 20,000 square yards. The main roads in the market were paved with 4in. by 4in. granite "setts" laid on a bed of concrete 8in. thick; the joints in the paving were run in with a composition of pitch and tar; the area of the granite "sett" pavement is nearly 9000 square yards. The entrance gates are a very good example of wrought ironwork, and are made by Messrs. Smith and Co., of Birmingham; at each of the two entrances is a lodge for a caretaker. The buildings are of brick with Hollington stone dressings, and are covered with red tiles.

The site chosen for the market had one disadvantage, inasmuch as it was low lying meadow land and had to be filled up from 6ft. to 7ft., requiring from 80,000 to 100,000 cubic yards of material. This rendered the foundations costly, and also necessitated the continuous use of a steam roller to consolidate the material. The works were commenced in July last year, but the contractors were very much hindered by the severe weather last winter, and the completion of the work was delayed at least two months thereby. The estimated cost of the works, including cost of land and filling up site, was £32,000; the actual cost will be about £30,000.

The new market was opened by the Mayor of Nottingham, Mr. W. Lambert, on the 28th September, and on that occasion he was presented with a very handsome gold key with which to perform the ceremony. The company present at the opening included Earl Manvers, Sir Henry Bromley, Colonel Seely, the majority of the members of the Town Council, the magistrates

THE ARLESEY PORTLAND CEMENT WORKS—PLAN.

(*For description see page 291.*)



for the borough, and a large number of gentlemen in the town and county interested in farming and agriculture. After the opening ceremony the company very closely inspected the market, and afterwards the invited guests, numbering about 130, adjourned to the Council Chamber for luncheon, which was provided by the Mayor.

The borough engineer, Mr. A. Brown, was complimented by the chairman of the committee, by the Mayor, and by other speakers upon the successful completion of the market and on the manner in which the work had been designed and carried out. The new market has been designed by and has been carried out under the immediate superintendence of the Borough engineer, Mr. Arthur Brown, M. Inst. C.E., assisted by the deputy engineer, Mr. Charles Mason.

The contractors for the buildings, offices, &c., were Messrs. G. Bell and Son, of Nottingham; for the stone work of bridge, drainage, and general engineering works, Messrs. Foster and Barry, of Nottingham; and for the ironwork, Messrs. E. C. and J. Keay, of Birmingham. The concrete pavement has been laid by Messrs. Cordingley and Sons, of Bradford, and Mr. W. Holloway has ably acted as clerk of works.

THE IRON AND STEEL INSTITUTE.

The Autumnal meeting of the Iron and Steel Institute, commenced on Wednesday, Dr. Percy, the President, being in the chair. There was a fair attendance. Dr. Percy announced that Mr. Daniel Adamson, of Manchester, had been nominated President for the ensuing year by the Council, and the nomination was confirmed with acclamation by the meeting. Mr. Adamson, in returning thanks for the honour conferred on him, said that he believed he was the first engineer or iron user, who had ever filled the chair, and he would leave nothing undone to promote the best interests of the society.

Dr. Percy then delivered his address, which was less interesting in some respects than that which he gave at the last meeting of the Institute in London. He began by explaining that the meeting was held in London to give the members an opportunity of visiting the Indian and Colonial Exhibition; and for their guidance a report had been prepared on the iron-making resources of the British Colonies by Mr. P. C. Gilchrist and Mr. Edward Riley, which would be placed in their hands. We may say here that this report is a pamphlet of 137 pages, full of valuable information, the results of no fewer than fifty analyses of ores made by Mr. Riley being contained in it. Dr. Percy then went on to speak in high terms of the papers to be read, and he called attention to three in particular, on chrome steel, on the Indian system of casting chains, and on alloys of iron and chromium. He then reviewed at some length the history of chrome steel, which seems to have been first mentioned by Bertier in 1821. He found that steel alloyed with 1 to 1·5 per cent. of chromium forged well, carried a good edge, and presented a beautiful damask appearance when treated with dilute sulphuric acid. After referring to the labours of M. Rolland, Dr. Percy went on to speak of the Chrome Steel Company of Brooklyn. It was also made in Sheffield and in France. The special peculiarity of chrome steel was that it was not spoiled by being heated to a high temperature for a long period, while its tenacity exceeds that of every other steel. It pierces, but cannot be pierced by, every other steel. Chromium makes steel hard without making it brittle. Dr. Percy then called attention to a piece of ploughshare which he had obtained from Mr. D. Greig, of Messrs. Fowler and Co., Leeds, which Mr. Greig said was made in the United States, and was quite unequalled by any English share. It seemed to consist of a malleable iron core, with steel cast round it. He then dealt at considerable length with a patent being introduced into this country by Mr. Nordenfelt for the use of aluminium as an alloy for iron. Aluminium possesses the remarkable property of lowering the melting point of wrought iron and steel. In practice wrought iron was raised to the melting point and was in the condition of syrup. On the addition of ·005 per cent. of aluminium the metal became suddenly as fluid as water, and the occluded gases escaped freely. The cost of aluminium might interfere, but a new system was being tried with great success in which clay, carbon, and copper were heated in an electrical furnace to an enormous temperature, when the clay was reduced, the oxygen going to the carbon while the aluminium alloyed itself with the copper, from which it was subsequently easily separated. Dr. Percy insisted on the necessity for making extended experiments on the effect of other metals on iron—curiously enough he omitted all reference to Delta metal, an alloy of copper and iron, the copper largely in excess—and spoke of the celebrated column at Delhi, showing a needle forged from a small piece of the pillar which proved that it was wrought, not cast, iron.

Dr. Percy then plunged into statistics, which he possesses a singular aptitude for making interesting and even amusing. He took for his text a valuable report prepared by Mr. Jeans. We shall not attempt to follow him through this maze of figures; a few, however, will be found interesting and worth careful consideration. In 1879 the United States produced 2,741,000 tons—of 2000 lb.—of pig iron. In 1882, 4,623,000 tons. In 1885 there was a slight reduction, the quantity made being 4,529,000 tons. The capacity of all the blast furnaces in the United States is equal to 6,960,000 tons per annum. Of Bessemer steel there was made in 1879, 928,000 tons; and in 1885, 1,707,000 tons. The total capacity of the steel works is 4,102,000 tons per annum. There are eight works running the Clapp-Griffiths process with thirteen converters, capable of turning out 200,000 tons per annum. There are also eighteen open hearth plants with a yearly capacity of 5000 tons each.

In Great Britain there were 500,000 tons less pig iron made in 1885 than in 1880. Of Bessemer metal there was made in 1879 834,000 tons, in 1882 1,763,000 tons, and last year 1,300,000 tons. There are 119 converters in Great Britain, 76 of which were in use last year. If these were all worked up to their full capacity, they would produce not less than 5,000,000 of tons of ingots per annum. There are besides 276 open hearth furnaces, with a capacity of 3500 tons each per annum. It is worth adding that 200 tons can be got out of one of these furnaces in the same time that 50 tons could be got at first. On every side we saw reduction of cost got by reduction of manual labour. Thus it has been stated that one Nottingham lace machine can turn out as much work as 8000 women. The planing machine has reduced the cost of true iron surfaces from 12s. per square foot to a couple of pence. The work on gold chains which used to cost 30s. is now done for 3s. 6d. A gross of steel pens used to cost £7, they now cost 4d.; and one steel firm alone supplies 20 tons of sheet steel per week to be converted into pens. Dr. Percy gave some statistics concerning the railway system of the United States, which has a larger mileage by two-fifths than that of all the rest of the world put together. Not a pound of tin plates is made in the States. Bessemer iron ores are becoming so scarce, that not less than 2,000,000 of tons are imported annually from Europe.

Dr. Percy concluded with an eloquent peroration, in which he said that if we would be true to ourselves, and not make the mistake of underrating the powers of our adversaries, we need not fear the "demon, foreign competition."

Sir Henry Bessemer proposed a vote of thanks, seconded by Mr. Adamson, and carried unanimously.

The first paper read was by Sir Frederick Abel, C.B., F.R.S., and Colonel Maitland, superintendent of the Royal Gun Factories, Woolwich,

On the Erosion of Gun Barrels by Powder Products.

The peculiar action of powder products upon the inner surface or bore of a gun, as they rush from the seat of the charge towards the muzzle, whereby more or less irregular scoring or erosion, is produced, is ascribable to the co-operation of three causes, viz., a softening if not a fusing effect, exerted upon the surfaces of the metal by the high heat of the explosion, an increase of this softening or fusing effect by the chemical action of the sulphur upon the metal at the high temperature to which the surface of the latter is very rapidly raised, and the mechanical action of the rush of gases, vapours, and liquid products upon the softened or fused surfaces. The great increase which has been taking place during the last twenty years in the power of artillery has brought the subject of the erosion of gun barrels into prominence, and it is not too much to say that it now forms one of the chief difficulties to be encountered by the maker of a heavy gun. As far as can be seen at present, its sufficient mitigation is the one great difficulty which seems likely to impose a limit on the size and power of ordnance in the future. Erosion is of two kinds, technically known as muzzle-loading scoring and breech-loading scoring, though both kinds occur to some extent in all guns, whether muzzle-loading or breech-loading. Muzzle-loading scoring is produced by the rush of the powder products, over the top of the projectile, through the clearance, or windage, which has to be allowed for facility of ramming home the shot along the bore in a muzzle-loader. Breech-loading scoring is produced by the rush of the powder products behind a shot, acting as a gas-tight plug, during and immediately after its passage through the gun.

Muzzle-loading scoring takes place almost entirely in the upper surface of the bore, and that its effect diminishes greatly as the velocity of the advancing projectile increases. Breech-loading scoring, on the other hand, erodes the bore almost equally all round, and extends towards the muzzle, till the pressure of the expanded gas is so much reduced as to render it ineffective.

It is evident that, *cæt. par.*, erosion will increase with the amount of the powder products, with pressure in the bore, and with the duration of the time of action. Its inconvenience first began to be seriously felt in the 7in. muzzle-loading gun of 7 tons weight, which fired a charge of 30 lb. of powder with a shell of 115 lb. The great strides which have since been made in the weight of projectile and the amount of powder charge fired from heavy guns have resulted in increased rapidity of the deterioration of guns from this cause; and now, that it is proposed to arm the Benbow with 16¼in. breech-loading guns of 110 tons weight, which will fire a shell of 1800 lb. weight with a charge of 900 lb. of powder, the question of erosion becomes one of paramount importance. The 7in. gun above-mentioned was able to fire about 600 full charges before the bore had become so badly scored as to require its interior to be fitted with a new tube; this number of rounds was increased to about 1000 by the introduction of an expanding copper gas check, fitted on the base of the projectile. The adoption of breech-loading further increased the life of the gun by sealing the muzzle-loading scoring still more effectually; but on the other hand, it permitted the use of greatly increased charges of slow-burning powder; and the extensive erosion now speedily produced in some of the heavier breech-loading guns renders it probable that the interior surface of the 110-ton gun will require renewal after only a brief existence. Under these circumstances it becomes of very great importance to ascertain what material best resists erosion by powder products, or what treatment of the material is best calculated to increase its powers of resistance to erosion. It has long been known that pure copper possesses high power under certain circumstances of resisting wear by powder products in motion. For many years guns have been vented by having a plug of copper screwed tightly home into a hole drilled through the body of the piece, a fine vent-hole being then drilled through the centre of the copper plug. This description of vent resisted the wear of the gas better than vents of either cast iron, wrought iron, or steel.

In 1885 Captain Noble, C.B., F.R.S., of Elswick, conducted a series of trials with vents fitted to vessels otherwise closed, so that the whole rush of the powder products should pass through the vent. The experiments were carried out with varying charges of powder, and with vents made of steel of different qualities. Three kinds were employed, viz.:—

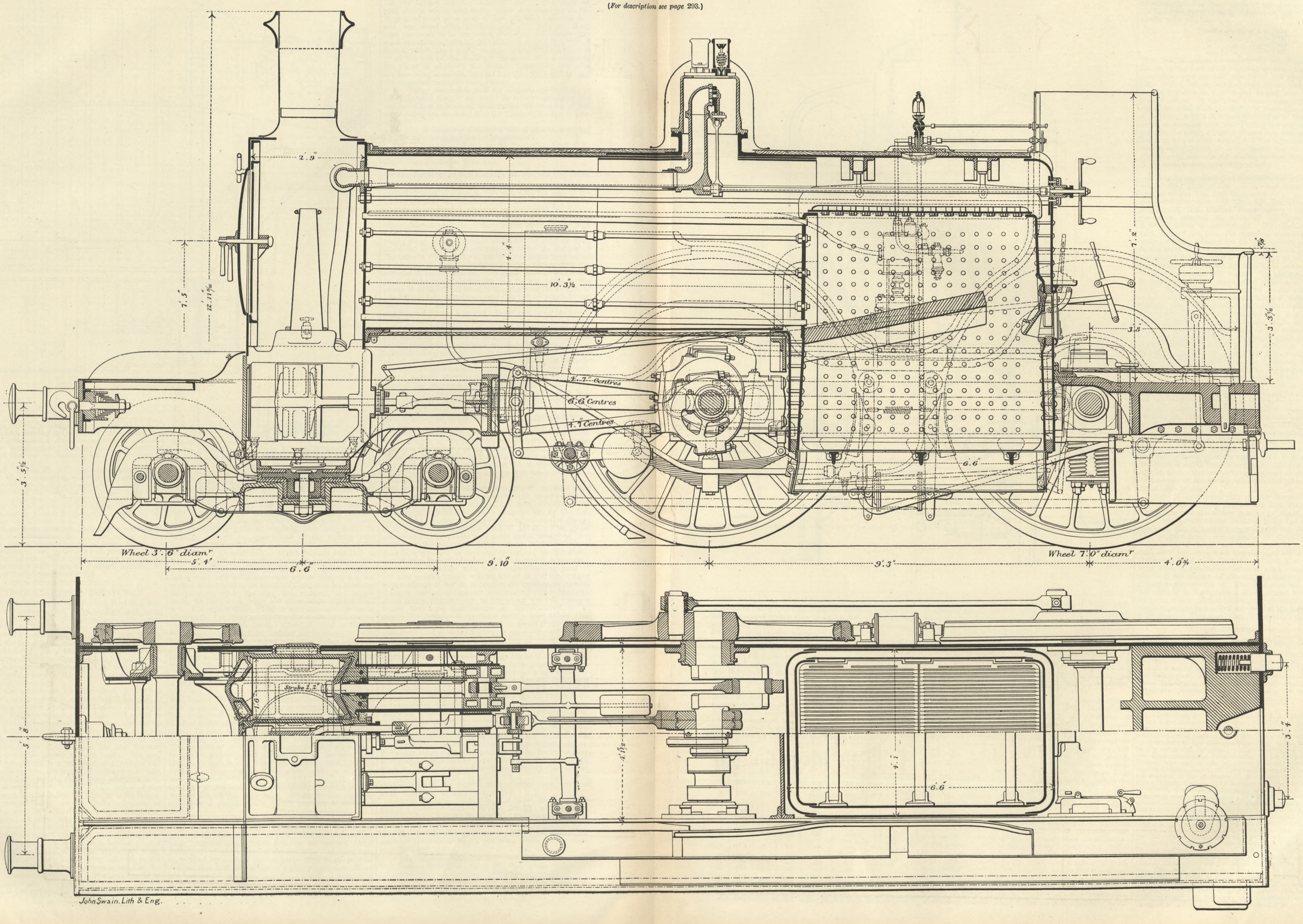
Hard steel, containing about	0·9	per cent. of carbon.
Medium steel „ „	0·4	„ „
Gun steel „ „	0·3	„ „

In Captain Noble's opinion the results showed that the milder the steel the less the erosion.

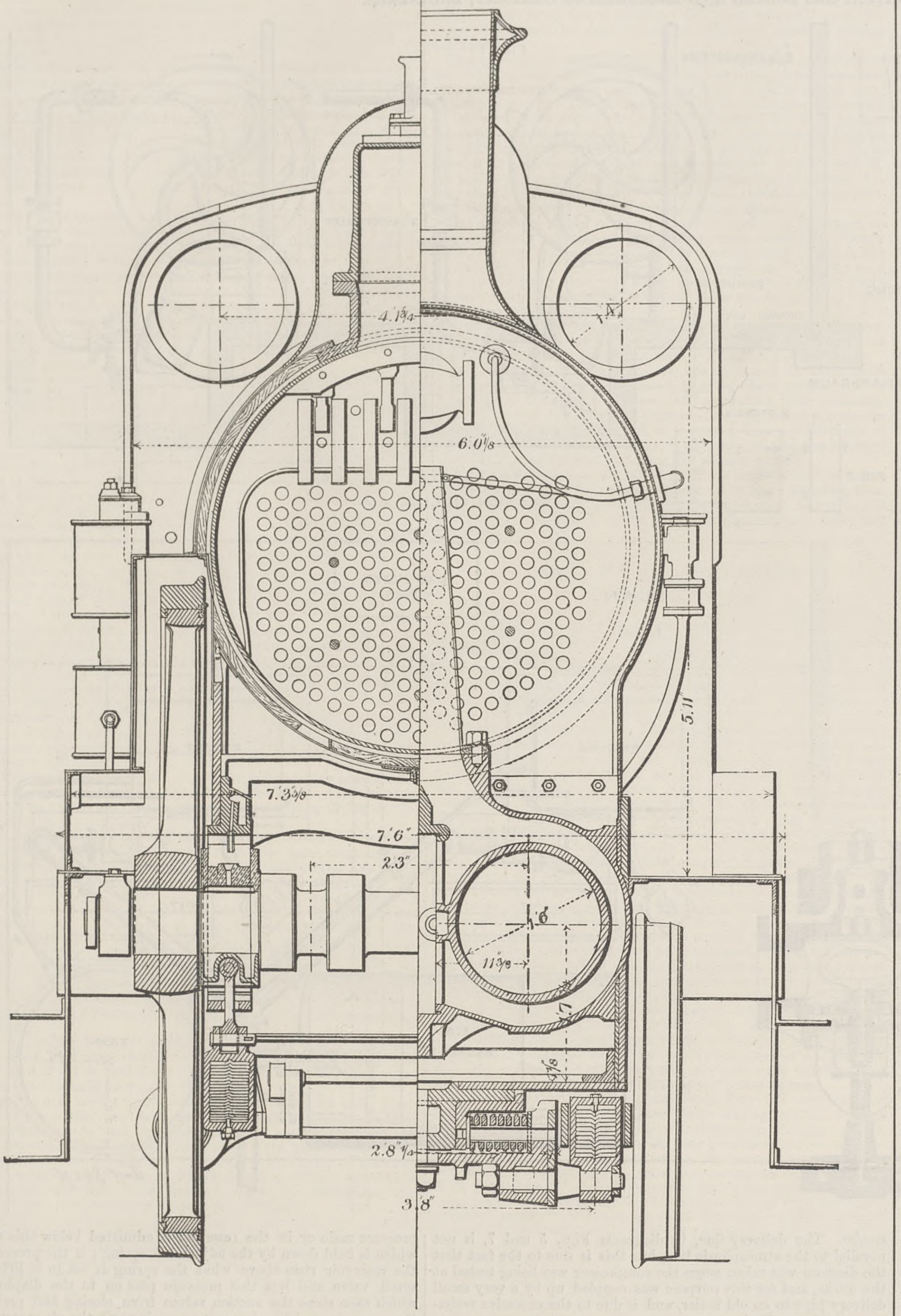
EXPRESS ENGINE, NORTH BRITISH RAILWAY.

MR. M. HOLMES, COWLAIRS, ENGINEER.

(*For description see page 293.*)



EXPRESS ENGINE, NORTH BRITISH RAILWAY.



The subject was now seriously taken in hand in the Royal Gun Factory, and an extended series of experiments was commenced with a view to endeavour to ascertain the true cause, under service conditions, of the variability found to exist in the resistance offered to erosion by the material composing different gun-barrels. Thirteen rifled steel barrels, of 2¼in. bore, were tried, firing 100 rounds each with 10¼ lb. charges of pebble powder and 6 lb. shot, fitted with service driving rings: these barrels were screwed into the mouth of the chamber of a 22 cwt. breech-loader. Gutta-percha impressions were taken after each batch of twenty-five rounds. During the preparations of the barrels specimens were cut in prolongation of the bores and tested mechanically, and the proportions of carbon, silicon, and manganese were determined in samples of the metal. The average pressure of the gas was about 13 tons per square inch, measured in the powder chamber.

The following table gives the results obtained:—

Order of merit.	Register number.	Mean order ten observations.	Percentage carbon.	Percentage manganese.	Percentage silicon.	Broke at (hardened in oil 1450 deg.)	Remarks.
1	8568	1·9	·219	·529	·107	32·6	
2	8570	2·1	·233	not determined.	not determined.	25·2	Unhardened.
3	4707	2·5	·414	·086	·059	44·0	
4	8705	4·1	·333	·655	·093	47·6	
5	7494	6·0	·216	·475	·054	35·0	
6	2124	6·2	·160	·320	·042	27·1	
7	2047	6·4	·172	·255	·119	28·2	
8	7380	7·9	·391	·780	·064	52·4	
9	1624	8·0	·520	1·050	not determined.	66·2	
10	7647	9·8	·241	·664	·068	38·4	
11	7188	11·0	·347	·407	·051	40·6	
12	8938	12·0	·182	·050	·330	27·4	
13	tool steel.	13·0	1·144	not determined.	not determined.	not determined.	

An inspection of the table shows that both ordinary chemical examination and machine testing fail altogether to account for the position of the barrels in order of merit. Thus the worst and the worst but one are respectively the highest and nearly the lowest in carbon, the hardest and nearly the softest. The first, the fifth, and the tenth are very closely allied, both in analysis and machine testing. Whatever the action of carbon, manganese, or silicon might be, whatever effect hardness or softness might have, in promoting or retarding erosion by powder products, and by the passage of the projectile through the bore, it now became evident that some agency, hitherto unsought for, overpowered them and dominated the results.

The writers of this paper were led by these results to take up two independent lines of inquiry. One entered upon a complete chemical examination of specimens of those metals which had exhibited similarity in composition and considerable differences in their resistance to erosion, and instituted an examination of their structure as developed by chemical reagents. Information was also sought for by the careful determination of the specific gravities of several of the specimens. The other experimenter, guided by the shape and size of the pieces from which the barrels had been cut, determined to isolate the work done on the metal by forging, and to determine its effect on resistance to erosion. The results of the two inquiries are given in the paper in the words of the official reports made by the writers.

"The results obtained may be summarised, though not equally consistent throughout the series of specimens thus examined. They appeared to indicate that the difference in the extent to which the different barrels were eroded by powder charges was, at any rate to a considerable degree, to be referred to the amount of mechanical treatment which the metal had received, and to the consequent extent to which uniform fibrous structure had been developed. It appears that the more steel is worked or forged, the less it suffers from the eroding effect of powder-gas. There may be some slight difference in the resisting power of the surface, due to high or low carbon, but that is small compared with the effect of putting plenty of work upon the material."

Since the foregoing report was submitted, a careful determination has been made of the specific gravities of the four specimens therein referred to, and the following results were obtained :—

Specific gravity of a = 7·844
„ „ b = 7·847
„ „ c = 7·849
„ „ d = 7·850

These results appear to confirm the correctness of the inference in the first of the quoted reports—that the comparatively high specific gravity of the specimen in the large series, which ranked first in its power to resist erosion, was due to that metal having been worked to a greater extent. A barrel of Parson's manganese bronze is also under trial, with the object of comparing the influence of working, with a different description of metal, upon its power of resisting erosion. During the early experiments, given in the table, a barrel of cast iron was also tested; it broke up at the sixth round, but the experiment was conclusive, nevertheless, as it was found that the erosion was very considerable—being greater, in fact, than in the best of the steel barrels after fifty rounds.

It is to be regretted that the discussion which followed was of very little utility. This is not remarkable, however, as no one had any experience to go on except the authors of the paper. A letter was read from Lieutenant Jacques, of the United States Navy, asking if the specimens referred to were all cut from the same ingot or taken promiscuously. Mr. Vickers, of Sheffield, pointed out that the chemical composition of steel could not alone account for its peculiarities, contradictory results being often obtained. Mr. Adamson held that the quantity of foreign matter in the shape of carbon, &c., in a gun steel must affect its liability to erosion. We fail to understand what this means. He also maintained that tempering steel in oil was a great mistake and did much harm. Mr. Markham confounded erosion with corrosion, and did not therefore contribute much of value to the discussion. Sir F. Bramwell explained that the experimental barrels were screwed into the chambers of guns, in order that the action of the powder gases might be intensified, so as to shorten the duration of the experiments. It had been observed that the exhaust pipes in oscillating engines leading straight to the condenser were much eroded in process of time, but the steam trunnions were not. As the size of a gun increased, the surface subjected to the erosive action of the powder gas diminished in a rapid ratio, and thus the wear and tear was vastly augmented in large, as compared with small sorts of guns. Mr. Hall—of Messrs. Jessop—stated that his firm was now making a gun specially constructed to prevent erosion, concerning which particulars would be made public in due time. Sir Henry Bessemer said the action was possibly like that of the sand blast, and suggested that experiments should be made with meal powder to test this point. Colonel Dyer stated that the said erosion took place in the pipes of hydraulic press pumps, where no sand blast action could possibly occur. Mr. Vickers added to his former remarks that fifteen years' experience with steel led him to conclusions entirely opposed to those of Mr. Adamson on oil tempering, which he said gives the highest elastic limit to steel.

Colonel Maitland, replying on the discussion, answered several questions, and pointed out that the products of fired gunpowder are either gaseous or liquid, and that as one of the barrels which behaved badly had not been oil tempered, Mr. Adamson's argument fell flat. Sir Frederick Abel supplemented the remarks of Colonel Maitland. Sulphur did no doubt act on the gun, for he had found sulphide of iron in powder deposit taken out of a gun. As to the sand blast view, he did not think that would hold water, because gun-cotton behaved even worse than gunpowder in the matter of erosion, and there were certainly no hard particles with it. The steel used was taken from that actually in the service. He concluded by saying that the paper was imperfect because the experiments were not complete, and it had only been read at the earnest request of Dr. Percy. This concluded Wednesday's proceedings.

EXPRESS ENGINE, NORTH BRITISH RAILWAY.

In our impression of the 17th ult. we gave illustrations of the fine bogie engine exhibited at Edinburgh by Mr. M. Holmes, locomotive superintendent of the North British Railway. We publish this week, as a supplement, a sectional elevation and plan of this engine, and also two half cross sections. A tabular statement of dimensions will be found on p. 234, Sept. 17th.

The Invention of the Sextant.—Dr. J. L. Dreyer points out, in the *Astronomische Nachrichten*, No. 2739, an historical error which has crept into several astronomical works, although it was refuted some fifty years ago by Prof. Rigaud in a series of papers communicated to the *Nautical Magazine*. In the books referred to, it is stated that the principle of the construction of the sextant was communicated to John Hadley by his brother, a Captain Hadley, who had in his possession a sextant given to him by Captain Godfrey, brother of Thomas Godfrey, of Philadelphia, the real inventor of the instrument. But it appears there never was such a Captain Hadley. The brothers of John Hadley were—one a barrister, the other a physician; and he himself was not an instrument maker by profession—as has been asserted—but, as an amateur, occupied himself with mechanical pursuits, and was the first to bring the polishing of reflecting telescopes to any perfection. On May 13th, 1731, John Hadley communicated to the Royal Society a description of his reflecting octant; and, after some hesitation, Halley declared himself satisfied that Hadley's idea was quite different from that of Newton, who had invented an instrument founded on the same principle. It is no doubt true that Thomas Godfrey, a glazier of Philadelphia, had invented an instrument of this kind about the year 1730; but the first intelligence of his invention did not reach England before the month of May, 1732, in a letter from James Logan to Halley. Godfrey's instrument was made of wood by Emund Woolley, a carpenter, about November, 1730, and had been tried on board the ship Truman, of which John Cox was master. The first model of Hadley's octant had, however, been constructed by his brother George about the middle of the summer of 1730.

AIR-COMPRESSING MACHINERY, BEAUMARIS SEWERAGE WORKS.

THE BRITISH GAS ENGINE AND ENGINEERING COMPANY, ENGINEERS.

AIR COMPRESSOR DIAGRAM

FIG.5

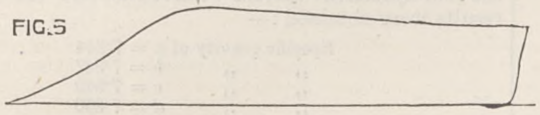
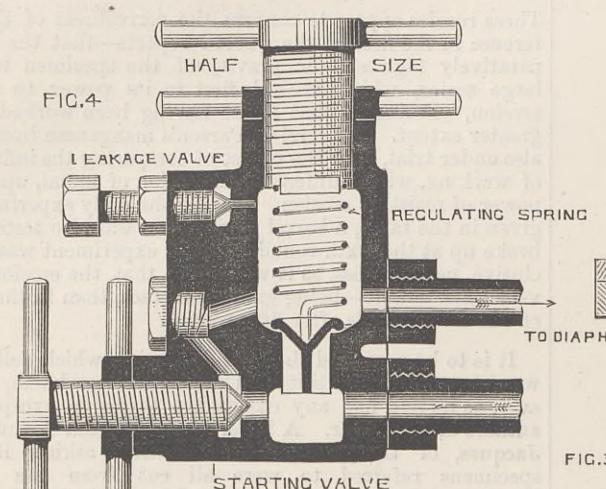


FIG.4



EASING VALVE

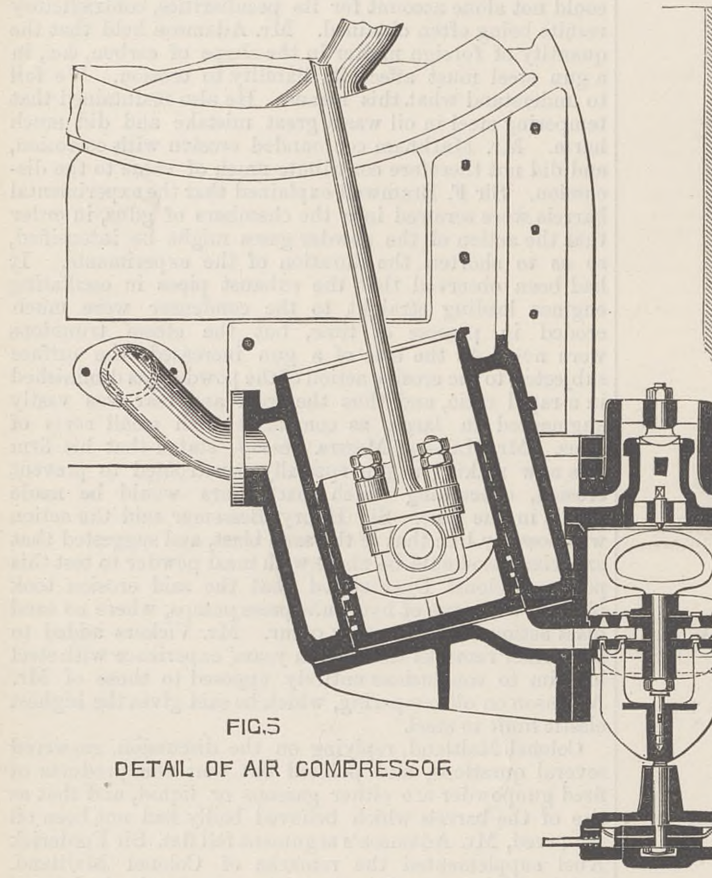
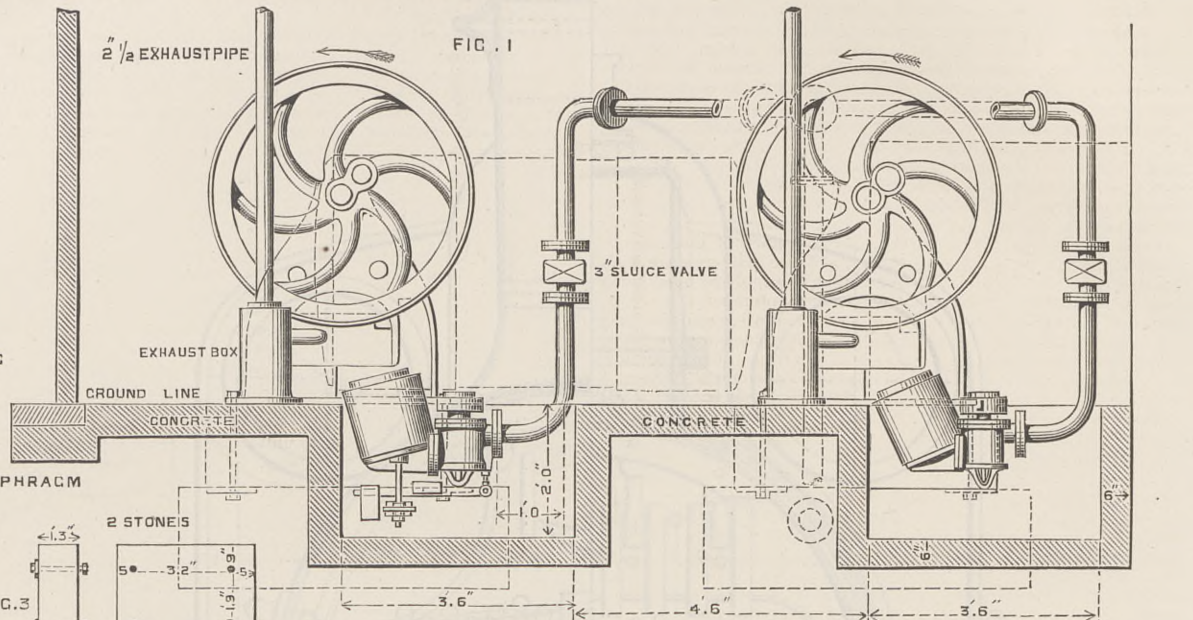
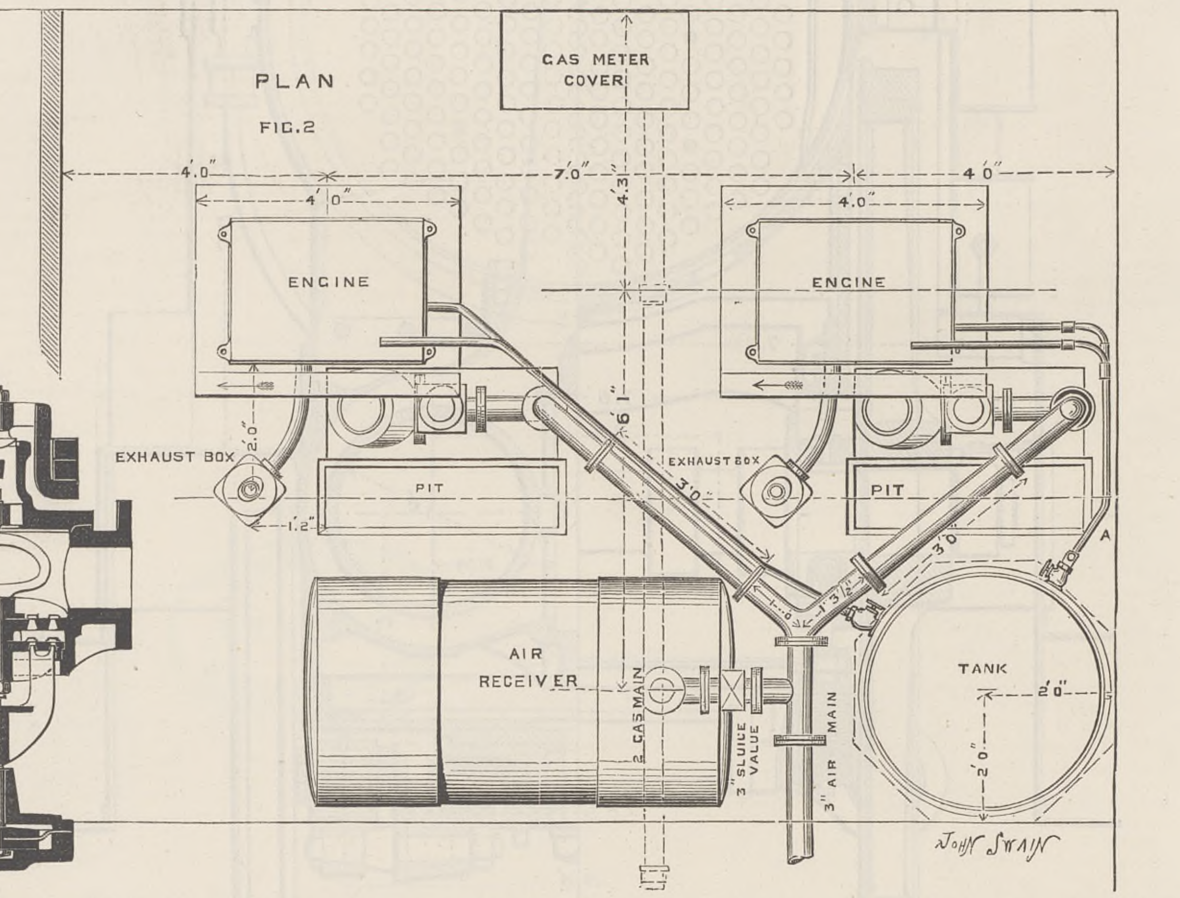


FIG.5

DETAIL OF AIR COMPRESSOR



SECTION ON LINE A.A.



PLAN

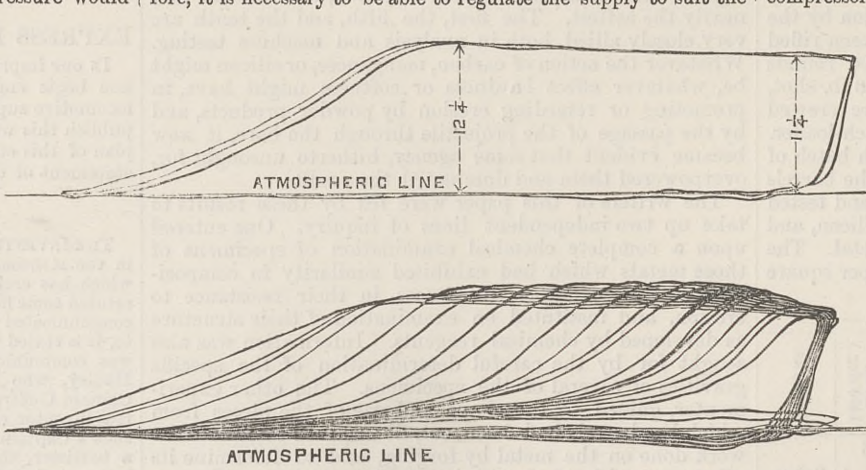
FIG.2

ATKINSON'S AIR-COMPRESSOR, BEAUMARIS SEWERAGE WORKS.

The machinery we illustrate above comprises Atkinson's air-compressors for low pressures, such as those required for Shone's sewerage system. Air-compressors for, say, 50 lb. pressure and upwards are common commercial machines, which are made of several very satisfactory types; but this cannot be said of compressors to work at pressures below this and higher than can be obtained satisfactorily from a fan or blower. A suitable compressor for over 50 lb. pressure is a very unsatisfactory compressor for 10 lb.; valves suitable for the higher pressure would probably cause a resistance of at least one pound in drawing in the air, and another pound in expelling it—say two pounds in all. This amount on a mean pressure of 40 lb. or 50 lb. is not a very serious proportion, but on a mean pressure of seven or eight pounds is a very considerable percentage of the power put into the air. The air-compressor shown at Fig. 3, is specially designed for dealing with these low pressures, and in conjunction with Atkinson's differential gas engine, is the arrangement of two-horse power combined engines and pumps supplied by the British Gas Engine and Engineering Company to the Beaumaris Corporation to compress air for working Shone's pneumatic sewerage system, which has been adopted by that town.

It will be seen from the illustration that the pump is single-acting; there is a short passage at the bottom of the cylinder leading to space between the suction and delivery valves. These valves consist of annular thin rings of phosphor bronze or Delta metal, closing annular passages in the seatings; ribs on the under side of the delivery seating guide the suction valves, and a guard plate guides the delivery valves. The whole of the valves, seats guides, &c., are threaded on a central bolt, having a handle at the top, and are so arranged that, presuming anything should go wrong with the valves, they can be removed by taking off the top cover and lifting out the valves by the handle; a duplicate set can be put in and the cover replaced, the whole operation being done in two minutes. The valves are very light, and have only $\frac{1}{16}$in. lift to give a very large valve opening, and, as will be seen by the indicator diagrams, the suction line cannot be defined from the atmospheric line excepting at the commencement of the suction stroke caused by the resistance of the air to being put into motion. It will also be seen that compression commences coincidentally with the commencement of the return stroke. The delivery line, in diagrams Figs. 5 and 7, is not parallel to the atmospheric line, but this is due to the fact that the diagram was taken when the compressor was being tested at the works, and for this purpose was coupled up by a very small delivery pipe to an old boiler, and is due to the excessive resistance of this small pipe.

In Shone's pneumatic sewage system the compressed air is stored up in a reservoir, from which the ejectors obtain their supply as they require it, so that the demand for the compressed air is intermittent and variable; for economical reasons, therefore, it is necessary to be able to regulate the supply to suit the demand, and for this purpose the easing gear is specially applicable. It consists of a lifter sliding on the end of the bolt which unites the valves and seats, and has ribs or fingers that rise up close to the under side of the suction valves; if this is lifted up it holds up the suction valves so that the air drawn in to the compressor, instead of being compressed, is expelled out through the suction valves so long as these are held up. The lifter is lifted by the diaphragm shown below it, and which is suspended from the valve-box by a couple of bolts; if pressure is admitted below the diaphragm the lifter is forced upwards so as to hold up the suction valves; this pressure is regulated by the easing valve shown in the separate view, Fig. 4. It is a small valve fixed in any handy position; the pressure of the air in the pressure main or in the reservoir is admitted below this valve, which is held down by the adjustable spring; if the pressure in the reservoir rises above what the spring is set to it lifts the small valve and lets this pressure pass on to the diaphragm, which then stops the suction valves from closing and prevents the pump from delivering any more air until the air pressure in the reservoir falls, when the easing valve is closed by the spring, and any air pressure below the diaphragm is allowed to escape through the small leakage valve, which is always left a little open for this purpose. It is sometimes necessary to start these compressors when the air reservoir is charged; if they were allowed to compress air this would be difficult with a gas engine, but by opening the starting valve the air pressure is allowed to pass round the easing valve, and so long as there is any pressure at all in the reservoir the suction valves cannot close until this starting valve is closed.



ATMOSPHERIC LINE

Figs, 6 & 7—AIR COMPRESSION DIAGRAMS.

The delicacy of the action of this easing gear is surprising, as shown by the series of diagrams, Fig. 7, taken when the reservoir is charged to the desired pressure to which it is set, and the diaphragm governor was acting on the suction valves. The successive discharges of air take place later and later until the suction valves are held firmly up and the diagram becomes a straight line. The instant air is drawn off from the reservoir the suction valves commence to work so as to give partial deliveries for a small demand, or full deliveries if the pressure falls more than a fractional part of a pound. It is also evident that excepting the diaphragm itself, which is trifling in cost and easily replaced, there are no working parts subject to wear or that can get out of order. The valves of the compressors, owing to their small lip, show no sign of wear beyond being just bright where they seat themselves. The combined engine and compressor take up very little room, and can be placed in charge of any intelligent man or lad. The engine room at Beaumaris is 16ft. by 12ft., and contains two of them, besides the air reservoir and cooling tank, leaving ample room. Each of these engines will lift 10,000 gallons of sewage 26ft. high at the furthest ejection station per hour, at a cost of threepence per hour with gas at four shillings per thousand feet, a result which speaks well for Mr. Shone's system and for the subject of our notice. The engines and air compressors this company are supplying to the Houses of Parliament to work Mr. Shone's system there are similar in construction, but have double-acting compressors and the engines are larger.

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

(*From our own Correspondent.*)

THE Autumn Session of the Iron and Steel Institute accounted for the absence from market, at Wolverhampton yesterday and at Birmingham this—Thursday—afternoon, of certain prominent members of the trade. The fact, however, that we are now only a week from the quarterly meetings, and that finished iron buyers are very generally postponing new operations until these gatherings, minimised the importance of the absence of ironmasers in London. It is gratifying that there is a better feeling in trade this week, and next week's meetings are anticipated with satisfaction. Inquiries are more numerous, and increased confidence is finding expression among some of the best informed members of the trade. The last quarter of the year will, it is believed, show some revival.

October finds the mills and forges in possession of more specifications than a week or two ago, and under these deliveries are being rapidly made, some proprieters being able to supply at once out of stock accumulated during the latter half of September.

In some instances rather better inquiries are reported from buyers for export, but the demand for country consumption refers principally to small lots, and the works continue only irregularly employed. The greatly improved position of colonial buyers in consequence of the continued advance in the values of wool is still regarded by ironmasters here as a most encouraging feature for the future of business.

The galvanising sheet trade is moderately employed at ruling rates, but makers look forward to quarter-day in the hope that firmer prices may be then obtainable. This week they are again asking 2s. 6d. to 5s. advance on the late minimum, but it is not easy to get any rise. Prices vary very considerably according to the state of the makers' order-books, and according to the exact nature of the specifications offered. For any orders that are at all out of the general run makers prefer to quote against specifications rather than to name an offhand price. Doubles are quoted £6 2s. 6d. to £6 5s. at makers' works, and lattens £6 17s. 6d. to £7. Some local buyers, on the other hand, there are who affirm that they are securing doubles at 5s. per ton less than these figures, and lattens at 2s. 6d. less. For 30 gauge sheets, which are rolled by only few firms, the quotation is £9 per ton, and makers declare that there is nothing in the business even at this figure. The advanced price of spelter is strengthening the hands of the galvanisers. These manufacturers up to a week or two ago were freely selling at £9 10s. Liverpool for 24 g., ordinary brands.

Galvanisers are just now receiving suggestions from customers in the Australias regarding the fluting of galvanised corrugated iron. Buyers are urging the adoption of a standard gauge in the fluting of the iron and the number of sheets to the ton, according to gauge. There are so many brands of corrugated iron in the neighbourhood with different sized corrugations, that, Australian buyers urge, it would be an immense advantage to dealers here if a standard gauge were adopted, so that the difficulty of fitting two brands together would be obviated.

In the plate trade prices are kept down by the severe competition from the North of England, Lancashire, and North Staffordshire. Tank plates are £6 10s. to £6 15s.; and boiler plates, £7 10s. to £8, and on to £9.

The bar trade keeps up fairly well on orders, mainly for medium and common qualities, for shipment and for local consumption. The opinion is stronger this week than last that quarter-day prices for best sorts are likely to show but little quotable change.

The list of John Bagnall and Sons is:—Bars, 1in. to 6in., £7; 6½in. to 9in. flat bars, and 4½in., £8 10s.; 4⅝in. to 4¾in., £9; 4⅞in. and 5in., £9 10s. As to rounds only, the large sizes are:—5⅛in. and 5¼in. £10; 5⅜in. to 5½in., £10 10s.; 5⅝in. to 5¾in., £11; 5⅞in. and 6in., £11 10s.; 6¼in. to 6½in., £12 10s. Hoops and angles are quoted at £7 10s., and rivet iron at £8 10s. to £9 10s., according to quality. Sheet quotations are:—20 g., £8 10s.; 24 g., £10; and 27 g., £11 10s.; but these quotations are hardly more than nominal. Boiler plates are £8 10s., £9 10s., £10 10s., and £11 10s., according to quality.

Steel is selling freely, imported from Wales, Sheffield, the North of England, and other steel-working centres. Blooms and billets are quoted at £4 5s. delivered. Rough steel plate ends are about £3 10s., and sheared to weight, £4 easy.

Finished iron buyers who have been commenting upon the possibility of a reduction in ironworkers' wages affecting prices in their favour should note that the probabilities of such a reduction are more remote. The Northern ironmasters have pretty much withdrawn their claim for a drop. This district is unlikely to take any action without the North of England first obtains a reduction. Consumers who have been standing out of the market on this account have now no reason to remain out longer.

The pig iron market, mainly as regards imported sorts, is again strong this week by reason of a larger business doing, and of the increasingly favourable position of Cleveland and Scotch markets. Vendors of Northampton and Derbyshire pigs will not readily depart from the advanced quotations for which they have been lately holding out. Northamptons are an average of 35s. to 35s. 6d. delivered to works; and Derbyshires, 35s. to 36s. 3d., according to brand. Some sellers, indeed, are asking as much for Northamptons as for Derbyshires. Lincolnshire vendors continue to quote the advance of 2s. per ton which they have been lately claiming, but the 38s. 6d. to 39s. 6d. now asked is a prohibitory price.

Native pigs are 50s. for Shropshire sorts, and 52s. 6d. to 55s. for Staffordshire makes, with foundry pigs at 31s. to 32s. delivered, Birmingham.

Hematites are 50s. to 52s. 6d. delivered. The West Cumberland Iron and Steel Company, Workington, are endeavouring to push business more than heretofore in the counties of Staffordshire, Warwickshire, Worcestershire, and Shropshire in hematites and manufactured steel. They have just appointed Messrs. Wilson Lloyd, and Co., Wednesbury, their representatives for these counties.

Constructive and railway material engineers and machinists speak with more confidence just now of the prospects of trade in the early future than I have noticed for months past. I have this week been assured by directors of certain leading manufacturing concerns in this line that there are evidences of revival which cannot be mistaken. If the increased inquiries were only accompanied by increased contract prices the outlook would be much more satisfactory. The splendid amount of custom which the Indian railways bring the engineering workshops in this country shows signs of further valuable augmentation, and the South Staffordshire and Birmingham engineering shops are sure to get a fair share of the contracts.

This week the South Indian Railway Company is inquiring for 4000 tons of steel rails, 22,700 pairs of fish-plates, 91,000 fish bolts and nuts, 200,000 cast iron sleepers, 75,000 wrought iron tie bars, 153,000 wrought iron split cotters, an equal number of gibs, 400,000 cushions, 200,000 keys, and alternative tenders for 100,000 steel transverse sleepers. The Great Indian Peninsula Company requires steel rails, sleepers, tie bars, gibs, cotters, steel fishing pieces, axle boxes, and the like. The inquiry from the Southern Mahratta Company for cast steel trolley wheels and axles, and a supply of manufactured iron, is welcomed, as also is inquiry for roofs for locomotive sheds, wrought iron galvanised pipes, and the like by the Oude and Rohilkund Railway. Railway carriage workshops here are hoping to secure the ironwork and fittings for iron goods wagons just now needed by the South Indian Company.

The members of the South Staffordshire and East Worcestershire Institute of Mining Engineers paid a visit this week to the Mines Drainage Commissioners' splendid pumping engine at Bradley. After inspecting the machinery, they assembled at Dudley, when Mr. W. B. Scott, the Government inspector, spoke of the Royal Commission on Accidents in Mines, and alluded to the salient points in their report. Furnaces at the bottoms of shafts, he remarked, should be provided with dumb drifts, and fans should be so placed that an explosion would not render them useless. Mr. Scott pointed out how gratifying it was that South Staffordshire had succeeded in reducing the number of deaths from falls of roof to so low a number; but there was still room for improvement, and he commended the subject to them as mining engineers.

The question of mining royalties was discussed at a meeting of the Birmingham Trades Council on Saturday, when speakers endeavoured to show the injurious influence which they had upon the staple industries of the country, and the consequent lowering of the workmen's wages. Its bearing on competition with foreign countries was explained, and it was stated that whereas English royalties ranged from 3s. 3d. per ton in this district to 6s. 3d. in Cumberland, those of Germany and France were only 6d. and 8d. per ton respectively. The chairman remarked that when coal was dear they heard nothing about royalties, and it was a serious question whether owners could be dispossessed of them.

The members of the Midland Association of Gas Managers, at their quarterly meeting at Birmingham, have elected Mr. Henry Hark, Birmingham, president for the ensuing year. During the meeting Mr. J. F. Bell, Stafford, read a paper on "Coal-tar as a Fuel for Heating Retorts," which gave particulars of Mr. Bell's experience at the Stafford Gasworks, and it was followed by a discussion.

In consequence of the decreased value of residuals, the Wolverhampton Gas Company has announced an advance in the price of their product of 2d. per 1000ft., making it 2s. 6d. per 1000ft.

An attempt is being made to unite the operatives in the various trades with a view not, it is stated, to bring about strikes, but to devise more reasonable methods for protecting their interests. The ironworkers and miners of Oldbury have expressed themselves in favour of such a scheme, and it is stated that a conference of the miners of the Forest of Dean, Warwickshire, and the Midland Counties to consider this question, will shortly be held.

The operatives in the Walsall chain trade have decided to accept no modification of the masters' terms which shall be lower than their recent wages. They declare their intention of living on the "starvation allowance" of 2s. 6d. a week rather than make any concession.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The iron trade of this district is certainly developing a decidedly improved tone, and the better feeling to which I have made reference in previous notes finds an increasing and more definite expression, at least so far as makers and merchants are concerned. As regards users of iron I do not find that there is any appreciably increased weight of business coming into their hands to bring them into the market at present for any much larger quantity of iron than has been sufficient to cover their requirements for some time past, but there is unquestionably more inquiry in the market and more disposition to buy, with better prices obtainable than have been got recently. All this of course gives a more hopeful tone, and if it continues — although the immediate outlook does not point to any definite substantial improvement—cannot fail to give some stimulus to trade. The chief factor in the stronger tone which has come over the market is still, however, the restricted output, and it still needs to be followed up by a really better trade. There seems to be a disposition to take a more sanguine view of the future, and the reports from America are more encouraging. This week I saw a private letter from a gentleman connected with the iron trade, who has gone across specially to make himself personally acquainted with the prospects of trade in the United States, and he writes most favourably of the outlook there, the prospects of trade being better even than he anticipated. Before, however, any very confident feeling can be established as to a really better trade here, there must be some substantial movement in the large industrial branches which are the chief consumers of iron, and this does not yet show itself. The condition of the engineering trades remains without appreciable improvement, anything like real active employment being confined to a very few concerns, and these chiefly engaged on special work; the general complaint is still that orders are very scarce, and any new work coming upon the market is competed for at quite as low prices as ever.

In the iron market a fairly animated tone has characterised business during the past week, and there was again a full average attendance on the Manchester iron exchange on Tuesday, with a tolerably good inquiry for both pig and manufactured iron. Lancashire makers of pig iron have sold a moderately large weight of iron during the week, and they are now asking an advance of 6d. to 1s. per ton upon the prices they were taking last week, No. 4 forge being quoted at 36s. 6d. and No. 3 foundry at 37s., less 2½ per cent., delivered equal to Manchester, and they are indifferent about booking further orders even at their advanced rates. In district brands there has been a moderate business doing in foundry qualities, which are firm at 38s. 6d. for Derbyshire and 36s. 6d. for Lincolnshire, less 2½ per cent., as the minimum for delivery equal to Manchester, but forge qualities meet with only a very limited inquiry, and for Lincolnshire brands, to which what business there is doing is chiefly confined, it is difficult to get more than 34s. 6d. to 35s., less 2½ per cent., delivered into this district. In outside brands there have been some fairly large sales of both Scotch and Middlesbrough, and sellers have been able to get an advance upon late rates without difficulty.

Hematites are meeting with a better demand, and are firmer in price, 51s. 6d. to 52s., less 2½, being now quoted for No. 3 foundry delivered into this district.

In manufactured iron there is more business stirring, and makers, who are mostly pretty well supplied with orders, are asking an advance of 2s. 6d. per ton upon the recent minimum rates, bars delivered into the Manchester district being now quoted at £5, hoops £5 7s. 6d., and sheets £6 7s. 6d. for singles, and £6 12s. 6d. for doubles. These prices are not being held to in all cases; but it would be difficult to place out orders at quite the old rates.

It may be of interest to point out in connection with the recent advance in metals—and particularly in ingot copper, which has gone up £2 to £3 per ton during the past fortnight—that buyers are beginning to realise that, although there are heavy stocks of Chili bars, these are not in a useable state for actual consumption, and a spurt in the demand might very easily overtake the present means of refining, with the result that there might be a sudden rise in the price of ingot and manufactured copper.

Substantial progress is being made with the erection of the Manchester Jubilee Exhibition buildings, and this week the prospectus has been issued. In this it is stated that the plans of the buildings, which have been approved by the executive committee, are exceedingly simple and compact. The main building consists of a central nave 1022ft. long and 56ft. high, with a transept across the centre 370ft. long and the same height, and two lower transepts near the ends of the nave 60ft. wide. At the intersection of the nave with the central transept is a dome 90ft. diameter and 140ft. high, and at the intersection of the nave with the low transepts are square pavilions of a lower altitude. The spaces between the nave and the arms of the cross are filled with exhibition courts, in bays 30ft. wide. The machinery in motion is to be provided for in a large annexe, separated from the main building by a 70ft. roadway with a covered fireproof gallery of communication. The Exhibition is to be opened early in May, 1887, and is to continue open about six months. No exhibits are to be received before the 15th March, except by special permission, and all goods are to be delivered before the 15th April, and be in order by the 25th April under penalty of forfeiture of the deposit and space allotted. I understand that Messrs. W. and J. Galloway and Sons, of Manchester, have received an order for ten of their boilers to be laid down at the Exhibition.

A very compactly arranged combined engine and boiler, suitable for agricultural requirements, has just been introduced by Messrs. Richmond and Chandler, of Manchester, and which can either be mounted on wheels or made stationary. The engine is carried on the foundation bed independent of the boiler, to which it is only connected by the necessary steam and water pipes. By this arrangement not only are the various parts more accessible, but there is a freedom from the wear and tear of vibration, expansion, &c., which are inevitable under the old system of mounting the engine on the boiler. Another improvement is in the arrangement of the pump, which is usually an annoyance in small engines; this is driven at half the speed of the fly-wheel shaft, and is thus made reliable. A 1-horse engine and boiler only occupies a floor space of 2ft. by 3ft.

Mr. Miles Settle, of Darcey Lever, near Bolton, who recently introduced an improved water cartridge for blasting in mines, to which I have previously referred in my "Notes," has now turned his attention to the production of a perfectly safe electric lamp for mining purposes, in which he has also carried out his object with the aid of water. The lamp is of the incandescent type, and the special feature is that it is carried for protection in a glass bowl filled with water, and the contact for completing the circuit of the electric current is kept up by means of an ingeniously arranged float resting upon the water in the glass bowl. In the case of a fall of roof or other accident breaking the glass bowl the water is of course liberated, and the light is at once extinguished by the float dropping and thus breaking the electric circuit; or in the event of the lamp itself breaking inside the glass bowl the light would at once be extinguished by the surrounding water. This arrangement is applied both to lamps to be used in the working places or for lighting roadways, and Mr. Settle has certainly made an important step in solving one of the difficulties connected with the electric lighting of mines. As a further precaution the wires conveying the electric current to the lamps are carried in an india-rubber tube filled with water as a protection against any possible "sparking" in the mine.

The annual meeting of the Manchester Geological Society was held on Tuesday, and Professor W. Boyd Dawkins was elected president for the ensuing year. The society, which is largely devoted to matters connected with mine engineering, and has taken a very active interest in the question of lighting of mines, continues in a very healthy position, both financially and as regards the number of its members.

In the coal trade there is a fairly steady demand for house fire classes of fuel, upon which in some instances a slight advance upon last month's prices is being got, but all other sorts continue in slow demand, and quite as low in price as ever.

Barrow.—The tone of the hematite pig iron trade is firmer than it was, and there are hopes that at last a revival has set in which will bring about a state of activity at the furnaces throughout the district. Makers have booked orders well forward at current prices, and it is noticeable that users of iron are offering contracts of some magnitude at present rates, but these are not being readily accepted, and the bulk of the trade doing is in inconsiderable orders, although heavy contracts are offering all round. Prices are quoted at about 43s. per ton net for mixed parcels of Bessemer iron prompt deliveries, and 1s. to 1s. 6d. per ton on these prices for forward deliveries. Forge and foundry iron is quoted at 42s. per ton. Stocks are less than they have been for a considerable period, and large deliveries have lately been made out of stocks in order to reduce the great bulk of iron which has congregated at makers' works and in the hands of holders generally. But the future looks likely to be so much better that makers are not only able to reduce their stocks, but to increase their make. With this view a few furnaces will shortly be put in blast. There is a better feeling in the steel trade than has been experienced for some time. Makers are well sold forward, and have work in hand which will keep them busy for something like six months, and they are experiencing a demand which gives every indication of a great weight of steel rails and other material being required by America and other countries during the early future. Prices are firmer; tin bars are in fair but not active request. Plates are in quiet demand, but a fair trade is doing in merchant steel. Shipbuilders are still in an unsatisfactory position for orders. Their yards are poorly stocked, and workmen are being discharged to a considerable extent owing to the scarcity of orders. Engineers are busy in the marine department only. Iron ore finds a better market, and stocks are being still further reduced, prices ranging from 8s. 6d. to 9s. per ton at mines. Coal and coke a trifle dearer. Shipping fairly employed. Mr. J. T. Smith, speaking at the Mayor's Banquet held at Barrow on Monday, in reply to the toast of "The Town and Trade of Barrow," said there was a good time coming, and they could depend on it it was not very far off. Not only had the trade with which Barrow was associated, but, unfortunately, every other section of trade throughout the Empire, had been much depressed for some time, but every other country in the world had been going through a similar crisis with ourselves. He had the opportunity occasionally of going abroad, and he found distinct evidence that the depression which existed in other countries in Europe in connection with trade and industries was far more keenly felt than in this country; and the forecast of the future with them was not so hopeful, or by any means so comforting, as it was with those in Barrow in connection with the hematite trade. On Thursday next he was going up to London, and intended to bring before a Commission sitting there certain facts which he had been gathering for some time past in connection with the particular branch of the trade with which this part of the country was interested; and he meant to show there was not a very long future before us before the demand for hematite ore would be beyond the capabilities of this or any other country to produce. The requirements of America alone were increasing to such an extent that the trade was coming over to Europe, and the resources of this country were already being brought into play. No less than 160,000 tons of iron ore, pig iron, and steel had been shipped from Barrow alone to America lately, and more than half a million of tons had been drawn from Spain and from the Mediterranean. This latter source of supply was rapidly exhausting itself, and the whole world had been ransacked during the last few years in an endeavour to find hematite deposits of a similar character for the purposes of the steel trade. It was well known that steel required this particular class of ore, and therefore with the increasing prospects of the growth of trade in the States, and the natural growth of trade that would follow when one country began to move, he believed the unexampled period of depression through which we had passed in the iron trade of Great Britain would very soon be at an end. Whatever might be the state of depression for the moment, they could look forward to the future hopefully, and feel thankful they were coming to an end of bad trade.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

MESSRS. WILLANS, ARNOLD, AND CO., Spanish Steel Works, Attercliffe, have orders in hand for the supplying of certain patent furnace bars for steamships of the Guion and Monarch lines. These bars are the invention of John Nepomve Moreath, C.E., late chief engineer of the Austrian Navy, and permanent member of the Imperial and Royal Shipbuilding Commission. They are said to be a very simple and effective method of preventing smoke. The system consists of the automatic suction of air combined with the formation of vapour in a portable cistern in the ash-pit, which together are mixed in proper proportions, and at the proper temperature, with the developed carbonic oxide gas, thereby producing perfect combustion and consumption of smoke, while at the same time effecting an immense saving of fuel. A licence to manufacture and use the German patent at the Essen Works has been purchased by Krupp, and the system is in operation in London, Liverpool, Glasgow, Edinburgh, Sheffield, and other ports.

At the Spanish steel works here a trial resulted in a great saving of fuel and in the entire absence of black smoke. I had an opportunity of witnessing the operation of the invention last week. The boiler in trial was a double-flued Lancashire boiler of a nominal 28-horse power, and at the time it was generating steam for driving the entire machinery at the place. On every side the tall chimneys were sending forth black smoke, while that at the Spanish works was limited to a thin vapour, which was scarcely perceptible to the eye. The importance of the invention in diminishing the quantity of smoke will be more valued here with a view to a purer atmosphere than to its undoubted merits in economising fuel, as coal is so very cheap in this quarter.

Sir Frederick Thorpe Maffin, Bart, M.P., chairman of Messrs. Thomas Turton and Sons, Sheffield Works, Sheffield, was presented by the workmen with an illuminated address last Saturday, congratulating him on the attainment of the dignity of a baronetcy, and expressing their high appreciation of the many excellent qualities which have distinguished Sir Frederick's connection with the Sheffield Works for over a quarter of a century.

On Saturday a deplorable disaster occurred at the Wharncliffe, Silkstone, and Haigh Moor Collieries of Messrs. Pope, Pearson, and Co., at Altofts, near Normanton. Twenty-one workmen were killed, a considerable number injured, and fifty-three horses destroyed. The pits were considered about the safest in the district, employing altogether about 1100 men and 600 boys. The proprietors a year ago, acting upon a recommendation from the Home-office, introduced safety-lamps of the most approved type. The miners were opposed to these lamps, which they dislike owing to their giving a dim light; and it is said—though it has not yet been proved—that at the time of the explosion they were working with naked lights. Another cause is given—the escape of gas from old fittings. It is alleged that the form of light preferred by the men is the ordinary candle, stuck into a lump of clay for a candlestick. If this is the case, with such close muggy weather as Friday and Saturday last, it is no wonder that explosions occur, particularly if a fall of roof liberated any quantity of gas.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The Cleveland iron market was exceedingly firm during the whole of last week, and a considerable amount of business was done at advanced prices. There were, however, but few transactions at the market held at Middlesbrough on Tuesday last, not for want of buyers, but because sellers were reluctant to commit themselves for forward delivery. Prices are consequently still steadily advancing. Buyers now freely offer 30s. 9d. per ton for No. 3 g.m.b. for early delivery, but the majority of sellers ask 31s., which is an advance of 7½d. per ton on the market price of a week ago. For delivery over the first half of next year makers have hitherto sold small lots at 31s. 6d. per ton. They can now readily obtain 31s. 9d., but have raised their price to 32s., and refuse to entertain less.

Glasgow speculators are said to have given 31s. 3d. per ton for Cleveland warrants, but the volume of business done was not large, holders so believing it to be to their advantage to keep possession a little longer.

Shipments are proceeding satisfactorily, 13,915 tons having been sent away between the 1st and 3rd of October.

Orders for finished iron have recently been given out with rather more freedom than for some time past, for consumers are beginning to fear that prices may rise in sympathy with pig iron. Manufacturers, however, have not yet altered their quotations, and plates, angles, and bars can still be bought at the prices last quoted.

The stock of pig iron in Messrs. Connal and Co.'s Middlesbrough store was on Monday last 299,871 tons, which represents an increase of 84 tons for the week. At Glasgow they hold 823,809 tons, or 2572 tons more than when last reported.

The Cleveland ironmasters' returns for September were issued on the 4th inst. They have been anxiously looked for, and prove more satisfactory than they have been for some time past. During the month there were eighty-four furnaces in blast against ninety-two at the end of August. Of these only fifty-two are now making Cleveland iron, or twelve less than in August. The make of Cleveland pig iron was 116,109 tons, or 23,990 tons less, and the make of hematite and other kinds of iron was 74,611 tons, or 7624 tons more than in August. The make of iron of all kinds was 190,720 tons, representing a net increase of 16,366 tons. The pig iron in stock at the end of the month in the whole district was 720,422 tons, being a decrease of 7672 tons. These statistics are regarded as highly satisfactory.

September pig iron shipments amounted to 77,175 tons, being an increase of 8741 tons over those for August. Of this quantity, Scotland took 31,043 tons; Germany, 14,158 tons; America, 7080 tons; Russia, 5080 tons; Holland, 4295 tons; and Norway and Sweden, 3113 tons. Shipments of manufactured iron and steel were somewhat less than in August, only 35,700 tons having left, as against 37,260 tons previously. India has been by far the best customer, no less than 14,881 tons having been sent to that country.

The bi-monthly report of the accountant to the Board of Arbitration for the North of England finished iron trade, an epitome of which was given last week, showed that realised prices were virtually unchanged, and that puddlers' wages still remained at 2s. above shillings for pounds. With this report in their hands, and these circumstances in their minds, the members of the Iron Manufacturers' Association met on Thursday, the 1st inst., to consider whether or not they should demand a reduction of wages. On the one hand, in previous times of depression—for example, when Mr. Shaw Lefevre acted as arbitrator and made an award—wages have been relatively as much as 1s. per ton, or 10 per cent. lower than they are now; and such a reduction, if again carried, would afford enormous relief to the employers. On the other hand, it is unlikely that this or any reduction could be effected without going through all the loss of time and worry incident to an arbitration. Then it is exceedingly unlikely that the award would be in the employers' favour to any considerable extent. Another alternative would be to give notice to terminate the existence of the board itself—a step which a majority of the employers are averse to take; although all of them are well aware that it is at present a serious impediment to such a lowering of the cost of production, as might be expected to result in a considerable increase of output and re-employment of idle ironworkers. Whilst considering their future policy as regards the wages of their workmen, the employers have been compelled to take account of what would probably occur if a substantial improvement in trade did take place, accompanied by a rise in prices. Would not the operatives at once demand still higher wages, without giving credit for the proportionately high ones they are now enjoying? It is almost certain that they would do so; for the demand for their services would be on the increase, and they would be comparatively masters of the situation. The value of the necessaries of life would also be tending upwards, and the purchasing power of money downwards, so that unless they received more money for their services they would be distinctly worse off than at present. This is a state of matters they could not be expected to put up with, if they had any power to alter it. Under all these circumstances, the employers decided on the following resolutions, copies of which were duly forwarded to the operative secretary, viz.:—"That if the operatives undertake not to claim any advance in wages until the Dale sliding scale applied to the average net selling price justifies it, no formal notice be given at present for a further reduction in wages. This resolution shall not hereafter be interpreted to mean that the employers are debarred from claiming a reduction below the present rate if a still further fall in the net average selling price takes place." "That the secretary communicate the foregoing resolution to the operative secretary of the Board of Conciliation, with an intimation that the employers intend to bring the subject forward for consideration at the next general meeting of the standing committee." Judging by past experience, it is probable that the operatives will agree to these proposals, as affording them freedom from present disturbance of their wages rates. But it is greatly to be feared that, all the same, they will force the hands of their leaders, as they did in 1880, should the occasion arise, and should they feel they have the power—and especially as the individual members of the Board may then not be the same as those who belong to it now.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The Scotch pig iron trade has been excited this week, in consequence of the upward movement in the warrant market. Prices moved up last week considerably, and just at the same time an accident occurred at Gartsherrie Ironworks, which threw eight of the twelve furnaces blowing out of blast. This latter occurrence produced additional excitement in the market, and a very large speculative business was reported, prices advancing beyond what was anticipated, or what the circumstances of the legitimate trade appear to justify. The past week's shipments were poor, being only 7645 tons, as compared with 7861 in the preceding week, and 11,297 in the corresponding week of 1885. At the same time the arrivals of Middlesbrough pigs at Grangemouth were 8320 tons against 5790 in the preceding week, and 7635 in the same week of last year. The iron sent into Messrs. Connal and Co.'s Glasgow stores in the past week is 1294 tons, and it is probable that it will decrease in amount.

Business was done in the warrant market on Friday at 40s. 4½d. to 40s. 9d. cash. Monday's market was strong at 40s. 10d. to 41s. 3d. and 40s. 11½d. cash. On Tuesday transactions occurred at 41s. 1½d. up to 41s. 8d. cash, and 41s. 3½d. to 41s. 10d. one month. Wednesday's market was excited, with business done from 41s. 11d. to 41s. 3d., closing at 41s. 7d. cash. To-day—Thursday—being a holiday, no iron market was held.

The prices of makers' iron are advanced all round, as follows:—Gartsherrie, f.o.b. at Glasgow, No. 1, 46s. per ton; No. 3, 42s. 6d.; Coltness, 51s. and 44s. 6d.; Langloan, 46s. and 43s. 6d.; Summerlee, 47s. 6d. and 42s. 6d.; Calder, 47s. and 42s. 6d.; Carnbroe, 43s. 6d. and 40s. Clyde, 43s. 6d. and 40s.; Monkland, 42s. 6d. and 37s. 6d.; Govan, at Broomielaw, 43s. 6d. and 37s. 6d.; Shotts, at Leith, 45s. and 44s.; Carron, at Grangemouth, 46s. 6d. and 43s. 6d.; Glengarnock, at Ardrossan, 43s. 6d. and 40s. 6d.; Eglinton, 41s. 6d. and 37s. 6d.; Dalmellington, 42s. and 38s. 6d.

A serious disturbance occurred this week at Motherwell in connection with the strike of steelworkers at the works of Messrs. Colville. The men having declined to work at terms the employers felt justified in paying, and remaining out for a succession of weeks, it was resolved to bring workmen from England to execute the contracts of the firm, which were getting much in arrear. On the arrival of the men by train they were attacked by the strikers, and the town has since been in a state of confusion.

The past week's shipments of iron and steel goods from Glasgow embraced locomotives and tenders worth £10,700 for Kurrachee; a steam launch, £778 for Monte Video; machinery, £10,000, including a sugar mill valued at £7074 for Havana; sewing machines, £4429; steel goods, £14,602; and general iron manufactures, £25,100.

In the coal trade there has been rather less doing in the past week. As the miners still keep to short time of eight hours, working only five days a week, supplies are difficult to obtain at some of the collieries. No matter what size of an order a master may have, the men will not raise more than the regulation amount; and as there are practically no stocks at the West of Scotland pits, the restriction is making itself felt. If the coal masters can manage to tide over the present month, their difficulty is likely then to cease, as the pressure for shipment will then be over for the season. As soon as trade slackens, the men, if they follow the usual custom, will be ready to put out more coal than is required. The total shipments of coal for the past week are 16,000 to 17,000 tons less than in the same week of 1885. They include 20,340 tons from Glasgow, 122 at Greenock, 4121 at Ayr, 995 at Irvine, 18,190 at Burntisland, 4452 at Leith, 11,190 at Grangemouth, and 4307 at Boness. The prices are nominally without change.

A strike of miners which has lasted eleven weeks at the shale pits of the Clippens Oil Company has now concluded. The occasion of the strike was a reduction of 3d. per ton of shale, and the men have gone in on the compromise of only 1½d. being deducted, and they are to work five days of eight hours a week.

Actions have been raised in several of the Sheriff Courts of Fife by coalmasters asking for damages against individual miners for failing to work eleven days a fortnight in accordance with the regulations of the collieries. The Miners' Union has resolved to employ counsel to defend the actions. The opinion of the men appears to be that as the masters do not give them eleven days in dull times, they cannot legally exact it from them in busy times. Mr. Weir, the miners' secretary, informed a meeting of the men a few days ago that the f.o.b. price of coals had been advanced 3d. and the price of household coals 6d. to 1s. 6d. per ton, and it was resolved to send deputations to the masters to solicit an advance of wages equivalent to the amount by which they were reduced in February last.

The Oakbank Oil Company's shale miners, to the number of about 120, have been locked out for leaving work to attend a meeting of the Midlothian shale miners, whose object is to obtain 6d. a day advance and reduce the working hours. It is stated that the company has a stock of shale sufficient to last it for about three months.

During September 28,421 tons of new shipping was launched from Clyde yards, as compared with 13,331 in September, 1885. For the nine months the launches aggregate 138,890 tons, against 139,209 in the same period of last year. But the outlook of the trade is unsatisfactory.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

A slightly better tone has characterised the coal trade this week at Cardiff and at Newport, but has not been so marked at Swansea. In the matter of price there is no change, except in small steam, which commands 3d. to 6d. per ton more than late quotations on account of the improvement in the patent fuel trade. Cardiff sent away nearly 8000 tons patent fuel last week. A slight move for the better is shown in house coal collieries. This is about the time for working contracts, and usually an improvement sets in. Another colliery has been struck off the list—the Old Brithdir, one of the Dowlais pits. This was worked out last week, and the rails, &c., taken out.

Notices are out, I am sorry to learn, at Cymmer, and rumour states that other notices may be expected. The fact is that unless prices move out of the low level they are in coalowners who can afford to close will do so. It is not everyone who can afford to close and wait until better times; but the more who can the more hopeful it will be for a change. Present prices mean giving coal away without a benefit to coalowners, as the quantity sold does not make up for price.

Newport coasting trade last week showed more favourably than the previous week, 25,000 tons of coal being despatched.

There is a good healthful feeling at Newport shown in building, improvements, minor industries, &c. I was favourably impressed a few days ago on visiting the place. Sir George Elliott is evidently bent upon great things there. I see his collieries in the Rhymney Valley are doing well.

The Monmouthshire steam coals will be worked more briskly as the Rhondda lessens, and this must give an impetus to Newport, unless railway enterprise diverts that mineral wealth to Cardiff.

It is rather unfortunate for Cardiff that the corporation should have arranged its water supply. The present arrangement is, of course, admirable, and a bountiful supply of the purest water will be secured, but the expense will be over £300,000, and the hardship of the thing is that a sufficiency of excellent spring water can now be obtained from the Severn Tunnel as would supply a town of twice the size. I have heard that Bristol was offered the supply, but did not require it. This supply comes from the land springs.

With respect to the tin-plate trade, there cannot be two opinions but that the make has been too great. Since the stoppage and notices prices have gone up, and even wasters at 11s. 6d. have been caught at eagerly. Good plates now are quoted from 12s. 6d., and the figures 12s. appear to have gone out of the market, having had a longer permanance there than was good for men or masters. This week's tin-plate exports from Swansea will be large.

The reforming of the Ystalyfera Works promises well. Mr. Newton, for thirty years manager of the old company, is now to be managing director of the new; Colonel Sheppard chairman.

The Barry Company is advertising for 2000 tons of rails, 65 tons of fish-plates, and 135 tons of fastenings.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

It seems that this country is the last to be affected by the upward tendency of other markets, for whilst the iron trade is decidedly better in America, and in England, France, Belgium, and Austria it shows encouraging features, all that can be noticed here is that prices have no more such a downward tendency as heretofore. Yet most of the finished ironworks both in Silesia and Rheinland-Westphalia are at full work on season orders, the exceptions being those which make rails and wire rods, though steel rods are rather better called for just now. The State Railway Administration at Cologne has sent out tenders, to be awarded on the 20th inst., for 5150 t. of steel rails, 7100 t. of iron sleepers, 419 t. of fish-plates, besides a quantity of the smaller railway requirements. Further, a tender for twenty luggage and 604 goods wagons. This is so far welcome news for the respective works, but as the competition will necessarily be severe, especially from Belgium, which is so near at hand, prices will be cut to the finest point, and most probably leave no profit at all for any one.

Forge pig in Silesia still costs 38 to 42 and foundry 48 to 50 M. pt., but maintains its price with difficulty, though more forge is now being sold than some time back. The rolling mills have plenty of orders in hand, and are working full time. Below 85 M. p.t. the works would not book any more orders for forward delivery. Plates are not in quite such good request, and the lowest price is for coke 130, and for superior qualities 140 M. p.t. In Rheinland-Westphalia, buyers are still holding back orders for the new quarter in the hope of securing concessions on prices, but this the masters will not listen to; and, indeed, they cannot, for in most cases the present quotations leave no profit, and in the rest only a loss, and if the expected relief does not soon come the financial position of the works will be a difficult one this winter. Foundry pig Nos. 1 to 3 cost 43 to 50, forge 39 to 41, Bessemer 40 to 43, Spiegeleisen 45 to 46, Luxemburg forge 28 to 29 M. p.t. Common merchant bars cost 89 to 93, girders 85 to 90. Boiler plates 130 to 138; thin sheets 123 to 125; steel rails 115 to 125 M. p.t.

In France and Belgium prices are still quite firm, and some American orders have reached the latter country, but even with the addition of these the works have not now full work, so the combination has decreed a reduction of output of 10 per cent., but of course without altering prices.

There has been a sad accident at the coal mine "Consolidation" in Westphalia, the explosion having been caused, according to first impressions, by the ignition of coaldust, by which fifty men lost their lives and several others were badly mutilated.

There were paid in wages to the coal miners in the lower Rhenish-Westphalian coalfield last year M. 82,030,000, and as there were 101,700 recipients, that makes M. 806 per man, and it appears that wages make up 60 p.c. of the cost of getting the coal.

The Cockerill Steel Works project at Nicolajew has received a temporary check, inasmuch as the Minister of Communications has protested against the works being built on the plot of ground selected, because the Government might eventually require it for the extension of the commercial docks.

The coal market is seasonably brisk, but in coking coal and coke, by the restricted output of furnaces, there is necessarily less movement, and prices for all sorts of coal remain unchanged.

Northern Shipping.—The feeling that the great shipping interest of the North-eastern ports, and the industries allied therewith, have passed the worst and are beginning to improve, gathers strength. Whether there are substantial grounds for so pleasant a belief, or whether the wish is father to the thought, and the idea rests merely upon street talk and newspaper paragraphs, is not at all clear as yet. On the other hand, there is the undoubted fact that numbers of vessels lately laid up in port are now out at sea. Thus, three months since there were twenty-five steamers, aggregating over 20,000 tons, lying idle at Sunderland; now there are only two, with a capacity jointly of 2000 tons, and one of these is on the eve of her departure. The 600 seamen who at the same date were lounging about the streets have dwindled down to about 100. Freights are certainly better. A typical case is that of ore ships from Bilbao, which command 1s. 3d. per ton more than they did. Shipbuilders are receiving daily inquiries for new vessels, and now and then business results. A case in point is that of Messrs. Turnbull, of Whitby, who are about to build an iron vessel, which will employ a number of idle hands, and change destitution into comfort in many a cottage home during the ensuing winter. On the other hand, it must not be forgotten that the Baltic and Black Sea navigation will shortly be suspended by ice. This may bring a reaction. There will be keener competition for freights to other ports. The advantage gained may be lost, and with it the hopeful feeling which at the moment seems to prevail.

Afloat in a Crater.—Captain C. E. Dutton, of the U. S. Geological Survey, has been recently engaged in making a study of Crater Lake in Oregon, and the latest advices received from him show that he has discovered probably the deepest body of fresh water in the country. Leaving Ashland, Oregon, on the 7th of July, his party, escorted by ten soldiers, provided through the courtesy of the general commanding the military department of the Columbia, reached the brink of the wall of the lake on the 13th, having brought with them boats so mounted on the running gear of wagons as to bear transportation over a hundred miles of mountain road without injury. The boats bore the transportation without strain or damage, and preparations were at once begun for lowering them 900ft. to the water. The steepness of the wall was very great, being at the place selected about 41 deg. or 42 deg., and the descent partly over talus, above covered with snow, and rocky, broken ledges lower down. The boats entered the water quite unharmed. The process of sheathing them, rigging the tackle, and lowering them occupied four days. A couple of days were occupied in making journeys around the walls of the lake by boat—the only possible way—and in examining the rocks and structures of the wall in its various parts. Next followed a series of soundings. The depth of the lake considerably exceeded the captain's anticipations, though the absence of anything like a talus near the waterline already indicated deep water around the entire shore. The depths range from 853ft. to 1996ft., so far as the soundings show, and it is quite possible and probable that depths both greater and shallower may be found. The average depth is about 1490ft. The descent from the water's edge is precipitous; at 400 or 500 yards from shore, depths of 1500ft. to 1800ft. are found all around the margin. The greatest depths will probably exceed 2000ft., for it is not probable that the lowest point has been touched. The soundings already made indicate it as being the deepest body of fresh water in the country.—*Science.*

AMERICAN NOTES.

(*From our own Correspondent.*)

New York, Sept. 25th.

The railroad companies, large and small, throughout the States continue to be heavy buyers of iron and steel material, lumber, stone, and all kinds of construction material. The purchasing agents for several large Western railroad companies are now in Eastern markets negotiating for supplies, part of which are wanted immediately. The peculiarity of the railroad demand at this time is that requirements for the next six months are being provided for—a policy which is having an inspiriting effect upon the industries generally. Heretofore railway managers have deemed it unwise to buy for forward requirements on account of the uncertain tendency in the material market. Within the past few weeks Western railroad builders have placed contracts with railmakers for rails to be delivered in March, April, and May at 34 dols. Large orders have been placed within two weeks for passenger and freight cars, and at this writing there are negotiations in progress by the purchasing agents of the trunk lines between New York and Chicago for between 2000 and 3000 cars for coal, grain, lumber, and similar purposes. It has been stated on good authority that there are not half a dozen car works in the country able to take a large order and guarantee delivery of cars within sixty days. Car-making capacity is being increased, and two new works are being projected—one in Illinois, and the other in Tennessee. The makers of car wheels report a similarly active demand for wheels; car axle manufacturers have secured contracts from some fifteen railroad companies during the past two weeks for repairing purposes. The locomotive builders are busier than for two years, and ten locomotives have just been turned out at Philadelphia—where the largest locomotive works in America are located—which have a guaranteed speed of a mile in forty seconds. There is a great deal of urgent inquiry for all kinds of crude and finished iron and steel.

Railroad earnings are improving. Reports from forty-five roads for the month of August show earnings at 18,000,000 dols., against 15,560,000 dols. for August of last year. During the past eight months the railroad earnings show an increase, as against the same eight months of last year, of 6,000,000 dols. The consumption of all kinds of manufactured products and cereals is much in excess of last year's figures, but a portion of the apparent increase is due to the custom of carrying stocks larger than have heretofore been carried.

Pig iron quotations are 19 dols. for No. 1 foundry, 17 dols. for No. 2, and 16 dols. for gray forge, with variations above and below, according to quality. The store demand for finished iron is decidedly stronger than last week.

Reports from Pennsylvania, Ohio, and farther Western States this week show a very heavy demand for all kinds of manufactured products, covering iron, steel, hardware, cutlery, machinery, tools, agricultural implements, besides a heavy demand for cars, car wheels, locomotives, and railway material generally. All of the locomotive builders who have been consulted within three or four days admit that their orders for the past thirty days have been larger than for the previous six months, and that their assurances for work for the coming winter and spring are such as to lead them to place large orders for future delivery with the manufacturers of material. Reports just received from the leading car manufacturers in the Western States particularly, and specifically at Detroit and Chicago, show that railway companies are hastening in large orders, and that there will be no idleness or dulness during the next six months. Our leading trunk lines, and, in fact, every one of them, are crowded for car capacity, and iron, steel, coal, and lumber shippers are in many cases making grievous complaints about delays. Material is advancing from 1 dol. to 2 dols. per ton, and even anthracite coal will be advanced 10c. per ton on October 1st, and 15c. to 25c. per ton on November 1st. The effect of this announcement has been to stimulate consumers of anthracite fuel, as well as of bituminous and coke, to secure themselves by the placing of orders at fixed prices—which is being very generally done—the cumulative effect of which is to create the appearance of a great scarcity of material in the market, and to alarm the rank and file who are unable to secure early deliveries, with the strong probability of higher prices. Building material of all kinds is in very active demand, and in some lines there is an advance. The receipts of lumber are enormous at all Atlantic ports. The cause of this is, that in primary markets in the North-West and South-East there are attempts at combination by which prices will be advanced in November and December. Careful commercial authorities do not attach much importance to these rumours of advances in iron, steel, and lumber, but it is only proper that the tendencies in that direction should be recorded. There is a good deal of inquiry for foreign material this week, but very little business. The railroad companies are heavy purchasers of material, and construction is being crowded along pretty close on to the 4000 mile limit by October 1st. Rail blooms are quoted to-day at 26 dols.; nail blooms at 27 dols. 50c.; plate iron, 2c. to 2·15c.; angles, 2c. to 2·10c.; beams and channels, 3c.; old American rails, 22 dols.; English rails, 21 dols. to 21 dol. 50c. offered. The New York market presents a very animated appearance this week, and there are indications of increasing shipments in copper, and of an improving demand for lead and tin-plate. Western buyers are ordering tin-plate very freely, but the stocks in second hands are sufficient for all current demands.

NEW COMPANIES.

The following companies have just been registered:—

Holden (Railway and Tramway) Patent Chair Company, Limited.

This company proposes to acquire the whole or a moiety of the benefits arising from letters patent, No. 3778, dated 17th September, 1880, granted to John Holden, of Nelson, Lancaster, for improvements in the permanent way of railways and tramways. It was registered on the 24th ult. with a capital of £2000, in 80 shares of £25 each. The subscribers are:—

	Shares.
C. Horsfall, Brierfield, brewer	1
T. Horsfall, Brierfield, brewer	1
T. Howarth, Burnley, sizer	1
G. Horsfall, Nelson, licensed victualler	1
W. Roberts, Nelson, engineer	1
N. Astley, Nelson, brewer	1
S. Whitehead, Nelson, land agent	1
T. Culverley, Burnley, boiler maker	1
T. Ogden, Burnley, wine and spirit merchant	1

Most of the regulations of Table A of the Companies' Act, 1862, apply to the company.

West Australian Midland Land Grant Railway Company, Limited.

This company proposes to adopt an agreement of 31st August between the Midland of Western Australia Land and Railway Syndicate, Limited, and John Proffitt (as trustee for this company), for the acquisition of a contract or concession granted by the Government and Colony of Western Australia to John Waddington, for the construction of a railway from Guildford to the Greenough Flats, in the said colony. It was registered on the 24th ult. with a capital of £500 000, in £10 shares. Power is taken to promote and effect emigration to Western Australia by the establishment of depôts and agencies for emigrants in any part of the world. The subscribers are:—

	Shares.
B. Chapman Browne, C.E., Newcastle-on-Tyne	1
Stephen Mason, Glasgow, manufacturer	1
O. J. Trinder, 4, St. Mary-axe, shipowner	1
John Waddington, C.E., 35, King William-street	1
Col. S. J. W. Harley, C.B., 16, Vicarage-gardens, Kensington	1
A. O. Scott, 32, St. George-street, solicitor	1
J. M. McDonnell, Herne-hill, solicitor	1

The number of directors is not to be less than five nor more than ten; the subscribers are to nominate the first; qualification, 100 shares; the company in general meeting will determine remuneration.

Porter and Thomas Paint Company, Limited.

This company was registered on the 28th ult. with a capital of £5000, in £1 shares, to carry into effect an unregistered agreement of the 31st August between Henry Porter, John Thomas, and Charles Barker of the one part, and John Thomas, jun., of the other part, no particulars of which are given in the memorandum of association. The subscribers are:—

	Shares.
C. Barker, 37, Gracechurch-street, surveyor	1
H. Porter, Stockton-on-Tees, engineer	1
J. A. Thomas, Redcar, accountant	1
J. Thomas, jun., Middlesbrough, iron merchant	1
J. Thomas, Stockton-on-Tees, paint manufacturer	1
G. Pottinger, 23, Albyn-road, St. John's, S.E., surveyor	1
A. T. Jennings, 114, Gresham House	1

The number of directors is not to be less than three nor more than seven; qualification, 500 shares.

Pilgrim's Rest, Limited.

On the 23rd ult. this company was registered with a capital of £100,000, in £1 shares, to acquire and work mineral properties, and generally to trade as miners, smelters, and dealers in metals; power being also taken to develope the resources of any lands acquired by the company, to lay out towns and villages, and to construct public works of all kinds. The subscribers are:—

	Shares.
Cecil Buckland, 8, Chadwick-road, Peckham, journalist	1
W. Powter, 21, Gotha-street, South Hackney, clerk	1
E. J. Churchouse, 169, Clarence-road, Lower Clapton, clerk	1
Herbert Mott, 27, Brewster-gardens, North Kensington, accountant	1
Arthur Cohen, 49, Buckingham-place, Brighton, journalist	1
J. E. Sherman, C.E., Sunbury-on-Thames	1
G. H. Newman, 47, Waterton-road, Westbourne Park, secretary to a company	1

The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first directors (any subscriber being eligible), and are to act *ad interim*; the directors so appointed are to retain office until the ordinary general meeting in 1888. The qualification of a director will be fixed by the shareholders at the first or any subsequent general meeting, and until so fixed, no qualification will be necessary. The remuneration of the board is to be at the rate of 5 per cent. of the net profits, but in the aggregate is not to exceed a sum equivalent to £500 per annum to each director. No director is to receive a less sum than £100 per annum, and in the event of the percentage of profits being insufficient for the purpose, that amount to be paid or made up out of the assets of the company, irrespective of profits. This remuneration is to be exclusive of any special remuneration to the managing director, or to any director for extraordinary services rendered.

St. Leonards-on-Sea Pier Company, Limited.

This company proposes to construct and maintain a pier and approaches at St. Leonards-on-Sea, and in connection therewith, to erect baths, saloons, pavilions, waiting-rooms, and rooms for concerts, public meetings, exhibitions, &c. It was registered on the 23rd ult. with a capital of £25,000, in £5 shares, with the following as first subscribers:—

	Shares.
*R. J. Reed, Royal Victoria Hotel, St. Leonards	1
*A. Parks, 11, South Colonnade, St. Leonards, butcher	1
W. S. Allen, 7, South Colonnade, St. Leonards, fishmonger, &c.	1
*W. Carless, White Cross, St. Leonards, solicitor	1
*T. Elworthy, 24, Springfield-road, St. Leonards, architect	1
John Bray, 13, South Colonnade, St. Leonards, estate and land agent	1
*N. J. Vaughan, 113, London-road, St. Leonards, hotel proprietor	1

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

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

28th September, 1886.

12,274. Making Railway Sleepers with Chairs, J. Riley, Glasgow.

12,275. Attaching Ball Bearings to Velocipedes, &c., O. Pihlfeldt, Birmingham.

12,276. Weighing Machines, F. C. Lynde, Manchester.

12,277. Reversible Window Sash Fastener, J. G. Goodwin, London.

12,278. Sight-feed Lubricators, A. Budenburg.—(—— *Schaffer and ——Budenburg, Germany.*)

12,279. Gas Burners, J. S. Pearce, London.

12,280. Shaving Machine, H. S. H. Shaw, Liverpool.

12,281. Egg Beaters, G. H. Thomas, London.

12,282. Flame Deflectors for Upright Boilers, E. S. T. Kennedy, London.

12,283. New Alarum, T. Glennie and R. Glennie, Glasgow.

12,284. Washing Machines, J. Summerscales and H. C. Longsdon, Halifax.

12,285. Silk Gut Fishing Line, A. Williams, Redditch.

12,286. Sewing together the Ends of Calico, &c., for Calendering, &c., J. Worral, Dukinfield.

12,287. Forks for Toasting Bread, &c., J. Heap and J. Knowles, Halifax.

12,288. Securing Hooks to Frames for Packing Sealskin, &c., B. Shaw, Halifax.

12,289. Self-fixing Button, G. H. Ellis, London.

12,290. Gauze Weaving, W. Strang, Glasgow.

12,291. Compounds for Manufacture of Ale, &c., E. Manbré, Liverpool.

12,292. Dull Coffee Finings, E. Philips, Croydon, and R. Staveley, London.

12,293. Merry-go-rounds, E. Waterton, London.

12,294. Inserted Metal Protectors of Boots, &c., G. Mahaffy, London.

12,295. Separating Gold, &c., from their Ores, G. J. Atkins, London.

12,296. Railway Signalling Apparatus, W. J. Tripp, London.

12,297. Pipes for Smoking, C. Drain, London.

12,298. Atmospheric Gas Burners, R. A. Gilson and W. J. Booer, London.

12,299. Hydraulic Press for Bending Copper Pipes, J. Marshall, London.

12,300. Medicine for Curing Prolapsus, &c., C. Adenauer, London.

12,301. Construction of Parts of Furnaces, F. Fanta, A. Cohen, and E. Cohen, London.

12,302. India-rubber, &c., Gums, A. M. Wood, London.

12,303. Fire Kindlers, F. Edenborough, London.

12,304. Manufacture of Screws, A. Muir and J. Humphrys, London.

12,305. Combined Teachers' Desk, &c., J. C. Mewburn.—(*G. J. Dürrschmidt, Germany.*)

12,306. Rotary Pumps and Engines, J. H. Storey, London.

12,307. Ornamentation of Wood, &c., G. W. Ley, London.

12,308. Joints for Flexible Parts of Drapers', &c., Busts, G. J. Child, London.

12,309. Clamps employed when Combing, &c., Textile Materials, B. J. B. Mills.—(*A. Casse, London.*)

12,310. Ironing Lace, &c., L. Lindley, London.

12,311. Cooking Ranges, W. Morrison, Glasgow.

12,312. Sizing and Applying Colours to Paper, &c., J. Hildesheim and L. H. Watson.

12,313. Gauge Pin for Printing Presses, E. L. Megill, London.

12,314. Digging Machines, H. de Mornay, London.

12,315. Automatic Electric Cut-outs, A. Bernstein, London.

12,316. Coupling and Uncoupling Shaft, J. W. Lee, London.

12,317. Receiving, &c., Prepaid Messages, P. Everitt, London.

12,318. Automatically Weighing Substances and Filling Packages with the same, W. B. Avery, London.

12,319. Treatment of Raw or Manufactured Animal Fibres, H. E. Newton.—(*O. Chemin, France.*)

12,320. Spinning Hemp, &c., A. V. Newton.—(*J. Good, United States.*)

12,321. Water Gauge Fittings, J. P. Halket, London.

12,322. Feed Motion for Sewing Machines, A. F. Wileman, London.

12,323. Fountain Pens, H. H. Lake.—(*G. H. Sacket, United States.*)

12,324. Sewing Machines, N. Wheeler and W. F. Dial, London.

12,325. Cotton Gins, H. H. Lake.—(*F. D. Child, United States.*)

12,326. Moulds for Armour Plates, H. H. Lake.—(*John Illingworth, United States.*)

12,327. Roasting Coffee, &c., C. H. Bartlett, London.

12,328. Slubbing and Roving Frames and Lap Machines, J. Ashton and J. Moorhouse, London.

12,329. Locking, &c., the Safety Bolts of Sporting Guns, H. A. Silver and W. Fletcher, London.

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12,330. Waste-preventing Cistern, J. J. Tylor, London.

12,331. Stove Grates, &c., C. Swindell, Sheffield.

12,332. Elevated Single Rail Railways, &c., J. C. Jefferson.—(*J. T. Pullon, South America.*)

12,333. Cowl Heads for Ventilators, J. Weatherhead, Sunderland.

12,334. Parlour or Table Cricket Game, G. F. Firth, Wakefield.

12,335. Bottles and Bottle Stoppers, J. Gartside, Oldham.

12,336. Automatic Air Filter and Ventilator, J. Wood, Barrow-in-Furness.

12,337. Bolt Fastener, I. Jackson, Glossop.

12,338. Perforating Pottery, &c., F. D. Bradley and H. Snow, Longton.

12,339. Hair-cutting Scissors, F. J. Strong, Coventry.

12,340. Gas, A. G. Meeze, Redhill.

12,341. Tool-holder, C. Bowers, Manchester.

12,342. Street Sweeping Machines, J. J. Rhodes, Manchester.

12,343. Fire-extinguishing Apparatus, J. B. Hannay, Glasgow.

12,344. Reversing Motions for Use in Ring Spinning and Doubling Frames, &c., H. Wuchner, P. Müller, and F. Hessling, Manchester.

12,345. Checking Ballooning in Ring Spinning Frames, J. Schofield and T. Holt, Manchester.

12,346. Hot Air Engines, H. Robinson, Manchester.

12,347. Steam or Water Valve, G. Harling, Preston.

12,348. Shoots or Bolts for Locks, &c., J. Kay, Birmingham.

12,349. Sewing Boot Soles, G. M. Cruikshank.—(*J. Albrecht, Germany.*)

12,350. Stopping and Re-starting Tramcars, P. Rogers, Swansea.

12,351. Drying Hats, &c., A. H. Reed.—(*W. H. Kendall, United States.*)

12,352. Preventing Incrustation in Steam Boilers, J. L. Wade, Glasgow.

12,353. Smoke Prevention Apparatus, G. Pepper and F. T. Schmidt, Bradford.

12,354. Wick Tubes for Lamps, S. Banner, Liverpool.

12,355. Paper Files, A. Zeiss, London.

12,356. Iron and Steel, A. and L. Q. Brin, London.

12,357. Application of Electric Mercury Contacts to Telegraph, &c., Switches, R. Snyers, Belgium.

12,358. Flushing Water-closets, &c., O. Whittaker and W. Schofield, London.

12,359. Fencing Posts, J. Nichols, Birmingham.

12,360. Fire Irons, A. C. Wells, London.

12,361. Iron and Steel, C. J. Sandahl, J. Birchall, and J. Musson, Liverpool.

12,362. Iron and Steel, &c., C. J. Sandahl, J. Birchall, and J. Musson, Liverpool.

12,363. Iron and Steel, C. J. Sandahl, J. Birchall, and J. Musson, Liverpool.

12,364. Administering Anæsthetics, B. M. Wilkerson, London.

12,365. High Speed Engines, F. Dowling and C. J. Croft, Stevenage.

12,366. Adjusting, &c., the Ends of the Cords or Chains of Counterbalance Weights, G. W. Hobbs, London.

12,367. Fender Base for Corrugating and Bending Machinery, J. J. Lawrence, London.

12,368. Gas or Vapour Engines, A. Rollason, London.

12,369. Sewing Machine, T. H. Martin, London.

12,370. Boots, J. B. Candau, London.

12,371. Metallic Vessels, H. Lane and R. H. Taunton, London.

12,372. Asbestos Gas Stoves, W. Holbrook, Clapton.

12,373. Ventilating and Chimney Cowls, G. Wishart, Glasgow.

12,374. Extractor for Fire-arms, &c., T. Nordenfelt, London.

12,375. Packing Rings for Steam Engines, A. Ridge, Manchester.

12,376. Fire-lighters, A. Ridge, Manchester.

12,377. Distributing Electricity, &c., R. P. Sellon, London.

12,378. Electrical Railway Signalling Apparatus, H. Merzbach and S. O. Eisele, London.

12,379. Machine Guns, &c., A. Gybbon-Spilsbury, London.

12,380. Securing Tubes in Tube Plates, L. Verbeeck and E. de Raet, London.

12,381. Metallic Railroad Ties, &c., C. H. Sayre, London.

12,382. Preparation of Materials for the Treatment of Sewage, W. B. Hallett, London.

12,383. Metallic Bedsteads, A. H. Griffiths and E. Smallwood, London.

12,384. Steam Generating Apparatus, J. and J. F. Gilmore, and W. R. Clark, London.

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12,385. Fixing and Securing the Lids to Jugs, J. Clarke, Cobridge.

12,386. Looms for Weaving, C. Thompson, Halifax.

12,387. Controlling Horses when Driving, C. Thompson, Halifax.

12,388. Receptacles for Ashes, C. Thompson, Halifax.

12,389. Preventing Accidents in Opening and Closing Railway Carriage Doors, C. Thompson, Halifax.

12,390. Tramway Cars, &c., W. E. Fowler, Westminster.

12,391. Parallel Ruler for Slates, R. J. Urquhart, Chorlton-cum-Hardy.

12,392. Steering Perambulators, R. J. Urquhart, Chorlton-cum-Hardy.

12,393. Lubricating the Spindles of Spinning and Doubling Frames, J. Taylor, Manchester.

12,394. Springs for Road Carriages, H. F. Lloyd, Liverpool.

12,395. Cooling Water, &c., T. Hill, Glasgow.

12,396. Frictional Motion, W. Schischkar and G. Harrison, Halifax.

12,397. Regulating the Opening and Closing of Fanlights, &c., H. Whiteley, Halifax.

12,398. Adjustable Ball Bearings for Bicycles, &c., J. Aylward, Coventry.

12,399. Bicycles and Tricycles, W. Andrews, Birmingham.

12,400. Indicator for Railway Carriage and other Door Fastenings, J. Whitehead, Birmingham.

12,401. Opening, &c., Casements, &c., E. W. Taylor, Birmingham.

12,402. Ejector for Breech-loading Small-arms, E. G. Hanson, Birmingham.

12,403. Automatically Tightening Gearing Chains, W. M. Trousdale, Leeds.

12,404. Reflecting Telemeter, W. H. M. Christie, London.

12,405. Granulating Grain, &c., J. Ritchie, Liverpool.

12,406. Bins for Storing Grain, &c., J. Wilson, Liverpool.

12,407. Fixing Pipes to Buildings, &c., W. Macfarlane, London.

12,408. Tea, P. Homero, London.

12,409. Collar, &c., Polishing Machines, T. Cudlipp, London.

12,410. Boiler and other Furnaces, J. S. Booth, London.

12,411. Bathing Machine, H. Maples, London.

12,412. Smoke-consuming Stoves and Furnaces, W. P. Hoblyn, Cornwall.

12,413. Polishing Liquid for Brass, &c., W. C. Boult and F. J. Ryan, London.

12,414. Merry-go-rounds or Roundabouts, J. E. Robinson, Northampton.

12,415. Electro-motors, O. W. F. Hill, London.

12,416. Ratchet Braces, T. Bass, London.

12,417. Automatic Gauge Cock, P. Barclay, London.

12,418. Condensing Steam, G. Best, London.

12,419. Producing Distilled Water from Sea Water, A. L. Normandy, London.

12,420. Thermo-electrical Apparatus, B. Boothroyd, London.

12,421. Cementitious Slabs, W. D. Curzon, C. R. Williams, and the Patent Paving and Construction Company, London.

12,422. Telephonic Apparatus and Circuits, P. Rabbidge, London.

12,423. Springs for Saddles, C. C. Cotton, London.

12,424. Stoppers and Necks of Bottles, A. Johns, Manchester.

12,425. Cooking, T. James, London.

12,426. Safety Apparatus for Steam Generators, G. Downing.—(*E. Brouillet, France.*)

12,427. Burners for Mineral Oils, G. Loberg and T. S. Perkins, London.

12,428. Extracting Gold from Ore, E. R. Cummins.—(*G. Ph. Schweder, Portugal.*)

1st October, 1886.

12,429. Ends of Beer Taps for Barrels, J. Morley, Upper Saltley.

12,430. Pulley Boss for Grasping Various Sizes of Shafts, T. Sugden, Manchester.

12,431. Operating the Pile Cutting Knife in Looms, W. E. B. Priestley and W. Deighton, Bradford.

12,432. Sweeping Chimneys, W. Q. Portbury, Shanklin.

12,433. Curtain Hooks, J. G. Rollason, Birmingham.

12,434. Extinguishers for Hydrocarbon and other Lamps, F. R. Baker, Birmingham.

12,435. Drawing Compasses, J. Cadbury and J. G. Rollason, Birmingham.

12,436. Lady's Safety Pocket, F. Hughes, Ruabon.

12,437. Refrigerating Machine, E. Buss, Manchester.

12,438. Safety Guard for Tram Engines, &c., S. Collier and R. Plant, Birmingham.

12,439. Keyless Watches, H. M. Robottom, Shustoke.

12,440. Stop Motion for Doubling Winding Frames, H. Wren, Manchester.

12,441. Better Lacing of the Coverings to Flour Sieves, &c., H. F. Hitchcock, Belfast.

12,442. Automatic Height Measuring, S. J. Anson, Birmingham.

12,443. Ships' Logs, W. J. Kent and A. King, London.

12,444. Bottle and Jam Jar Cases, R. Rear, Manchester.

12,445. Shuttles used in Looms for Weaving, T. Martin, Halifax.

12,446. Starting and Stopping Tramcars, &c., G. Robson, Liverpool.

12,447. Preventing Slipping of Handles of Tennis and other Bats, T. G. Beaumont, Halifax.

12,448. Hydraulic Lubricator, J. Paton, Holyhead.

12,449. Seamless Rubber for Condenser Machines in Manufacturing Woollen, &c., Yarns, W. and J. Terry and F. Rawnsley, Halifax.
12,450. Misering, J. W. and C. Docwra, London.
12,451. Transmitting Rotary Motion to or from Electric Machines, J. H. Holmes, London.
12,452. Folding Box, J. W. Gill, Birmingham.
12,453. Converting Reciprocatory or Oscillatory into Rotary Motion, C. Noble and H. Haes, London.
12,454. Gloves, F. J. Martin, London.
12,455. Pencil Sharpeners, H. Binko, London.
12,456 Photographic Studios, &c., H. V. Weyde, London.
12,457. Carriage Springs, J. W. Berriff, London.
12,458. Oil Lamp for Preventing Explosion, &c., W. Fraser, London.
12,459. Holding Shaving Soap, K. G. R. Vaizey.—(*H. R. Best, United States.*)
12,460. Gas Cooking Ranges, T. Greenwood, Halifax.
12.461. Stoppers for Bottles, &c., J. Thornton, Halifax.
12,462. Ascertaining Accurately how many Persons Travel Daily Inside and Outside a Tram-car, &c., J. Heldmann, London.
12,463. Saws, F. C. Prouvay, London.
12,464. Breakwaters, &c., W. R. Kinipple, Glasgow.
12,465. Housings for Securing, &c., Ships' Boats, J. McLean, Glasgow.
12,466. Interlocking Railway Signal Levers, C. Brown and C. Rogers, London.
12,467. Furnaces, R. Thompson, Liverpool.
12,468. Lock Bolts, A. J. Boult.—(*F. A. Smith, United States.*)
12,469. Tool for Gauging, &c., Brooch Pins, R. Brown, London.
12,470. Concrete Blocks, E. Long, London.
12,471. Steam Pumps, J. H. Tangye and W. Johnson, London.
12,472. Withdrawal of Liquors from Bottles, W. J. Payne, London.
12,473. Regulating the Flow from Feeding Bottles, G. F. Metcalfe, London.
12,474. Shoes for Horses, &c., W. A. Dunn, London.
12,475. Automatic Valve, J. Y. Johnson.—(*L. Labeyrie, France.*)
12,476. Antiseptic and Germiside Inhaler, S. Hardwick, London.
12.477. Scoring Paste, &c.. Boards for Boxes and Cases, H. Gardner.—(*J. Scherbel and T. Remus, Germany.*)
12,478. Regenerative Gas Lamps, D. Hulett and R. Hurst, London.
12,479. India-rubber Guard for Penholders, &c., J. F. Warner, London.
12,480. Treatment of Sulphide of Sodium, F. H. Gossage, T. T. Mathieson, and J. Hawliczek, London.
12,481. Folding or Collapsible Receptacles, E. J. Feilden, London.
12,482. Curtain Hooks, W. T. Colyer, London.
12,483. Signalling Policemen, J. P. Brewer and W. C. Smith, London.
12,484. Folding Bed, J. H. Cairncross, London.
12,485. Extinguishing Mineral Oil Lamps, V. G. Webb, London.
12,486. Supplying Lubricating Material to the Bolsters or Upper Bearings of Spindles, W. Oxley, Manchester.
12,487. Utilising Tin-plate Waste, G. A. Goodwin and W. F. How, London.
12,488. Combined Pencil Eraser, Ink Eraser, and Pencil Sharpener, W. Russell, London.
12,489. Ascertaining Temperature, C. G. Hoffmann, London.
12.490. Charging and Discharging Grain, W. H. Beck.—(*E. Labois France.*)
12,491. Electric Clocks, V. Reclus, London.

2nd October, 1886.

12,492. Imitation of Stones on Wood Furniture, W. Wood and A. Simmonds, London.
12,493. New Game, H. W. Robinson, Northampton.
12.494. Floor-cloth, &c., J. H. Hunt and H. Thame, London.
12,495. Finishing of Hats, J. Taylor, Manchester.
12,496. Shears for Glass Bottles, W. Horn and R. Bell, Sunderland.
12,497. External Stoppered Bottles, A. Philburn and A. Moors, Ashton-under-Lyne.
12,498. Composition for Removing Scale from Steam Boilers, J. Brookbanks, Newcastle-on-Tyne.
12,499. Preservative Coatings for Ships' Bottoms, J. B. Hannay, Glasgow.
12,500. Metal Hooks, S. Bott. Birmingham.
12,501. Stretching Yarn, T. Frusher, Bradford.
12,502 Crutches and Walking Staffs, W. Daniels, Ashford.
12,503. Certain Parts of Metal Bedsteads, E. Peyton, London.—*7th August*, 1886.
12,504. Friction Coupling, W. Pollard and J. Pollard, London.
12,505. Umbrellas, &c., J. Broxup, London.
12,506. Covering the Steels used in Corsets, R. Simpson, H. Simpson, and B. G. Simpson, Sheffield.
12,507. Spinning and Twisting Spindles, S, Lucas, Sheffield.
12,508. Purifying the Feed-water of Steam Boilers, J. Turns, South Shields.
12,509. Roller Blind Furniture, J. G. Uttley, Manchester.
12,510. Pen Cleaner, H. P. Miller, London.
12,511. Cabineis for Books, &c., B. L. F. Potts, London.
12,512. Creation of a Current of Air in Ventilating Shafts, A. R. Waddell, Kidderminster.
12,513. Railway Chock, T. Snowball, Newcastle-upon-Tyne.
12,514. Lever Sash Lock, T. E. Lane, Birmingham.
12,515. Cutting and Sewing Button-holes, &c., C. Willson and W. Surfleet, Grimsby.
12,516. Promoting the Growth, &c., of Children, J. Sainty, Norwich.
12,517. Inscription Tablets for Memorial Wreath Cases, W. Ritchie, Glasgow.
12,518. Playing Cards, A. Lawson, Glasgow.
12,519. Joints for Driving Belts, J. Jardine and F. Arthur, London.
12,520. Liquid Gum, E. M. Knight, Halifax.
12,521. Water Meters, Rotary Engines, and Pumps, W. de Normanville, London.
12,522. Gas-fittings, E. Harrison and T. Chilton, London.
12,523. Oil Lamps, E. Harrison and T. Chilton, London.
12,524. Lock Nuts, J. Dunbar and J. J. D. Cleminson, London.
12,525. Cleaning Chimneys and Flues, G. Black, London.
12,526. Step Ladders, R. Baird, Forest Hill.
12,527. Steam Boilers, D. Purves, Dulwich.
12,528. Fire-extinguishing Sprinklers, R. Dowson and J. Taylor, London.
12,529. Apparatus for the Reception of Coin, &c., R. W. Vining and W. P. Thompson, Liverpool.
12,530. Governing Apparatus for Air Compressing Engines, F. France, Liverpool.
12,531. Distribution of Electric Energy, R. Dick and R. Kennedy, Glasgow.
12,532. Chemical Treatment of Bauhinia Vahli, J. H. Wilson, London.
12,533. Electric Bells, H. J. Coates and E. W. J Macdonald, London.
12,534. Primary Electric Batteries, H. Weymersch and R. McKenzie, London.
12.535. Manufacture of Sugar, A. and L. Q. Brin, London.
12,536. Cases for Containing Eggs, E. G. W. Packer, London.
12,537. Sanitary Appliance for Closets, &c., A. R. Waddell and F. G. Redman, London.
12,538. Construction of Throttle Valves, W. Jones, London.
12,539. Decoration of Wrought Iron Girders, E. C. Allam, London.
12,540. Show Boards for Advertising, E. C. Allam, London.
12,541. Furnaces for the Manufacture of Steel, R. Miller and N. E. Maccallum, Glasgow.
12,542. Plaster of Paris, E. R. Blundstone, London.
12,543. Loom for Weaving Velvet Pile Fabrics, A. Siret and J. L. F. Saulnier, London.
12,544. Adjustable Spanner, H. A. Couchman, London.
12,545. Lock-stitch Sewing Machines, F. Clift.—(*E. Bardili, Germany.*)
12,546. Carving Forks and Guards, H. A. Couchman, London.
12,547. Machines for Packing Tea, J. M. Day, W. R. Green, and H. C. Walker, London.
12,548. Producing Spray, &c., W. E. Heath, London.
12,549. Lamps, J. Hinks, London.
12,550. Stretching Trousers, &c., J. M. Presante, London.
12,551. Supporting Jars containing Honey, E. Jones, London.
12,552. Self-wringing Mop and Cleaner for Windows, &c., J. F. Warner, London.
12.553. Expanding Drill and Rose Bit, D. Gillies, jun., London.
12,554. Pianofortes, E. Kenshole, Aberdare.
12,555. Mats, &c., F. Greenland, London.
12,556. Tricycles, W. Freeman, London.
12,557. Insoles for Boots, &c., H. H. Lake.—(*C. W. King, United States.*)
12 558. Compressing Hay, &c. H. C. Capel, London.
12,559. Pipes of Sheet Metal, H. Kellerman, London.
12,560. Preventing Froth upon Beer, H. Stockheim, London.
12 561. Cartridges and Explosive Projectiles, H. S. Maxim, London.

4th October, 1886.

12,562. Weighing Machines, T. Finney, Langside.
12,563. Strengthening Metallic Boxes, H. H. Chilton, Wolverhampton.
12,564. Wooden Hoops for Casks, T. E. Morgan, Bristol.
12,565. Gully for Excluding Sewer Gas, R. Atkinson, South Shields.
12,566. Gas Fires and Stoves, T. Fletcher and A. Clare, Manchester.
12,567. Beaming Machines, H. Barnes, Halifax.
12,568. Washing Machines, F. C. Hall, Liverpool.
12,569. Instrument for Waving, &c., Hair, F. Iles, Birmingham.
12,570. Envelope, A. Butler, Leeds.
12,571. Pocket Apparatus for Taking Photographic Pictures, W. J. Lancaster, Birmingham.
12,572. Sizing Machines, A. Hitchon, Accrington.
12.573. Fixing and Working Sieves, W. S. Codner, London.
12,574. Automatic Draught Regulators, E. C. Mills, Manchester.
12,575. Measuring Taps, P. Skidmore, Sheffield.
12,576. Disgorgers E. H. G. Brewster, London.
12,577. Producing Divided Images for Photography, T. L. M. Hare and B. C. Le Moussu, London.
12,578. Coupling Railway Wagons, F. W. Dines, Norfolk, and J. Partridge, Essex.
12 579. Churning, W. Swarbrick and T. Houghton, Liverpool.
12,580. Forming Sockets in Blanks for Shovels, H. M. Myers, London.
12,581. Chest Protector, J. Robinson, Halifax.
12,582. Construction of Baths, C. K. Maxwell and S. Walker, Halifax.
12,583. Construction of Dressing Machines for Grain, &c., R. Howarth, London.
12,584. Removing Obstructions from the Front of Tramway Engines, J. Smith, Birmingham.
12,585. Affixing of Removable Standard Boards in Dressing Bags, E. T. and P. C. Wilkins, London.
12,586. Velocipedes, J. K. Starley, London.
12,587. Steering for Tricycles, &c., J. K. Starley, London.
12,588. Chimney Pot and Ventilator, W. H. Day, West Cowes.
12,589. Attaching Carriage, &c., Wheels to their Axles, E. M. Eadle, London.
12,590. Horseshoes, B. von Arnim, London.
12,591. Alarm Apparatus for Tramways, &c., J. Riedel, London.
12,592. Restoring the Surface of Raised Articles of Tin-plate, A. N. Hopkins, London.
12,593. Distributing Mailed or other Matter in Post-offices, S. Stewart, S. G. Browne, and W. Boby, London.
12,594. Carriage, J. Marston, London.
12,595. Secondary Batteries, E. Andreoli, London.
12,596. Mechanism for Gripping and Releasing the Cable and Applying and Releasing the Car Brakes and for Lessening Concussion and Varying the Speed of Cars in Railways having Traction Cables, J. H. Pendleton and C. Tiers, London.
12,597. Lock-up Ventilators for Buildings, H. J. Treasure, London.
12,598. Protecting Furs, &c., from Moth, C. Schandein, London.
12,599. Spinning Hair and other Fibres, J. J. Delmar and F. E. Tucker, London.
12,600. Small Sewing Machines, W. H. Steel, London,
12,601. Plates wlth Ribs or Projections, J. D. Ellis, London.
12,802. Cutting up Butts or Hides of Leather, E. Whatcott and E. and W. Bridgewater, Leicester.
12,603. Supplying Water to Water-closets, E. Gotto and F. Beesley.—(*J. Reid, Brazil.*)
12,604. Mechanical Movement, B McCabe, London.
12,605. Telegraphic Relays, A. M. Clark.—(*C. Diener, Austria.*)
12,606. Bottle and Jar Stopper, W. A. Larlham, London.
12,607. Artificial Boating, E. L. White, London.
12,608. Preparing Food from Cereals, J. Low, London.
12,609. Printing Music, S. Samper.—(*D. Fallon, Columbia.*)
12,610. Perfumery, P. H. Lecornu and A. Raynaud, London.
12,611. Bottling Carbonated Beverages, F. A. Reihlen, London.
12,612. Cockle Separators, H. H. Lake.—(*F. W. Howell, United States.*)

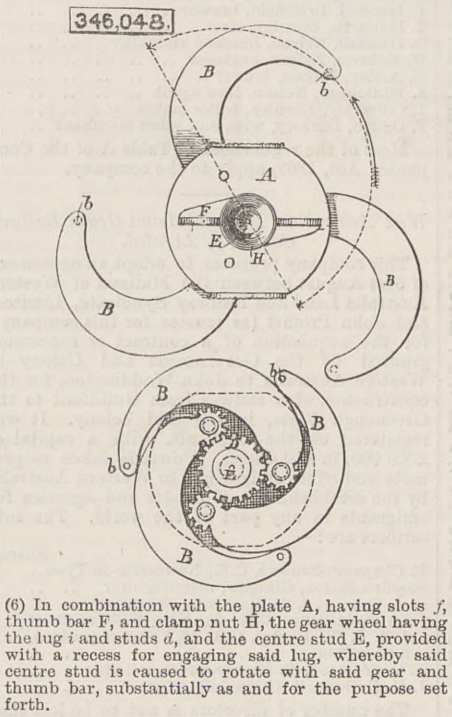
SELECTED AMERICAN PATENTS.

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

346,048. Temporary Centre and Templet Instrument, *Frank A. Humphrey, Worcester, Mass.—Filed March* 31*st*, 1886.

Claim,—(1) A tool for establishing and maintaining a centre over or within a cavity, provided with a series of excentrically pivotted swinging arms uniformly adjustable about a central disc or plate supporting an axially disposed centre or indent, which is adapted to receive the foot of a compass or similar tool, substantially as hereinbefore set forth. (2) A tool for finding and establishing a centre, consisting of a central plate or frame supporting an indent or centre mark, a series of swinging arms excentrically pivotted to said plate and uniformly adjustable by means of a centrally disposed gear, means for rotating said gear upon the plate, and a clamping device for retaining the parts at position of adjustment, substantially as set forth. (3) The combination of the plate A, the curved arms B, pivotted on said plate, and provided with pins *b*, the gear wheel D, the thumb bar F, connected with said gear wheel, the central stud E, having an indent or centreing point, and the clamping nut H, substantially as and for the purposes set forth. (4) The plate provided with the curved slots *f*, the wheel having studs *d* projecting through said slots, and the thumb bar F, having recesses f^1, in combination with the arms B and clamping devices, as and for the purpose set forth. (5) In a centreing tool, the arms B, curved in the manner shown, and expanding or swinging outward beyond the periphery of the supporting centre or plate, as set forth, whereby the outer edges of said arms are substantially circular and the tool adapted for use as a templet, as set forth.

346,048.

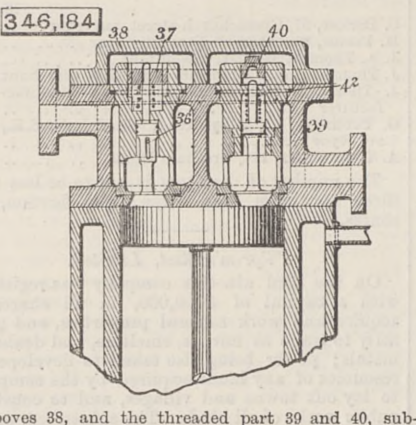


(6) In combination with the plate A, having slots *f*, thumb bar F, and clamp nut H, the gear wheel having the lug *i* and studs *d*, and the centre stud E, provided with a recess for engaging said lug, whereby said centre stud is caused to rotate with said gear and thumb bar, substantially as and for the purpose set forth.

346,184. Refrigerating and Ice Machine, *William H. Wood, New York, N.Y.—Filed December* 21*st*, 1885.

Claim.—(1) In combination with the diffusion valve chamber K, the valve and seat K^3 with spring, substantially as and for the purpose described and set forth. (2) In combination with a receiver and separator for a refrigerating machine, the sections B with the pipes B^5, substantially as described for the purpose set forth. (3) In combination with a refrigerating machine the distributing chamber C^2 with the flange C^5, double cone C^4, the pipe C^9, and the cover for the gas outlet pipes C^6, C^7, C^8, substantially as described for the purpose set forth. (4) In combination with a compression pump, valves, and cages, the collars 4, the steel pin 36^1, the nut with projections 37, and

346,184

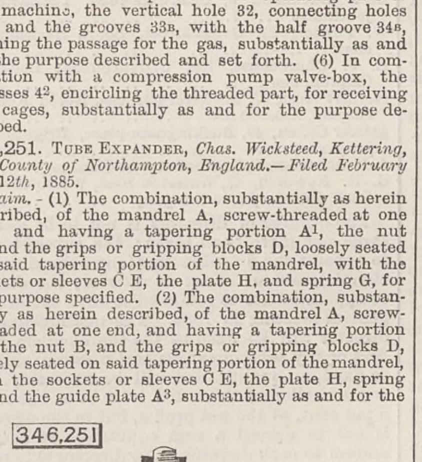


grooves 38, and the threaded part 39 and 40, substantially as described for the purpose set forth. (5) In combination with a vapour cock for operating part of the machine, the vertical hole 32, connecting holes 32A, and the grooves 33B, with the half groove 34B, forming the passage for the gas, substantially as and for the purpose described and set forth. (6) In combination with a compression pump valve-box, the recesses 4^2, encircling the threaded part, for receiving the cages, substantially as and for the purpose described.

346,251. Tube Expander, *Chas. Wicksteed, Kettering, County of Northampton, England.—Filed February* 12*th*, 1885.

Claim.—(1) The combination, substantially as herein described, of the mandrel A, screw-threaded at one end, and having a tapering portion A^1, the nut B, and the grips or gripping blocks D, loosely seated on said tapering portion of the mandrel, with the sockets or sleeves C E, the plate H, and spring G, for the purpose specified. (2) The combination, substantially as herein described, of the mandrel A, screw-threaded at one end, and having a tapering portion A^1, the nut B, and the grips or gripping blocks D, loosely seated on said tapering portion of the mandrel, with the sockets or sleeves C E, the plate H, spring G, and the guide plate A^3, substantially as and for the

346,251



purpose specified. (3) The combination, with the header E^1, having recess F^3, of the roller spindles F^1, having their ends rivetted over into said recess, and the set screw F^4, for the purpose specified. (4) The combination, substantially as herein described, of the mandrel A, the sleeve or socket C, provided with grooves N, sleeve or socket E, the nut B, the ball-bearings L, and the screws M, said parts being constructed for co-operation, substantially as set forth. (5) The combination, substantially as herein described, with the mandrel A, the sleeve or socket C, having an excentric groove W formed partly around its periphery, and the sleeve or socket E, having ratchet teeth formed around its periphery, of the nut B, having a ratchet flange B_2, the lever I, pawls K O, the pin U, and spring V, said parts being arranged for co-operation, for the purpose specified.

346,379. Sand Moulding Machine, *Matthew R. Moore, Indianapolis, Ind.—Filed March* 18*th*, 1886.

Claim.—(1) A yielding presser, platen, or follower comprising, essentially, a series of contacting independent movable sections, each section held against pressure by the constant force of a spring, and the whole arranged to serve with a flask and patterns and to yield irregularly to the sand, as set forth. (2) A yielding presser composed of independent movable sections having contact with each other, each section held against pressure by the constant force of an independent spring, and means, substantially as described, for adjusting the resisting force of each section independently, as herein specified. (3) A yielding presser, platen, or follower composed of a frame or containing piece A, in combination, movable sections or rammers,

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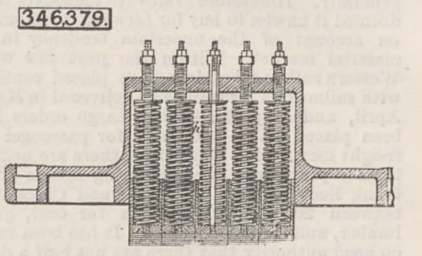

as *c c*, held out against pressure by means of springs, as *h h*, when adapted to be used in connection with a flask and pattern for the production of sand moulds for castings, as set forth. (4) In a machine for making sand moulds for castings, the springs *h h*, provided with separate and independent means, as *g g*, for adjusting their tension, in combination with the movable sections or rammers *c c*, and with the frame or containing piece A, the whole forming a yielding platen, operating in the manner and for the purpose substantially as described.

346,423. Electrical Connection and Guard Therefor, *George D. Burton, New Ipswich, N.H.—Filed January* 2*nd*, 1886.

Claim.—The combination, with an air brake hose section having a metallic coupling which forms a part of an electrical circuit, of a non-conducting disc carried

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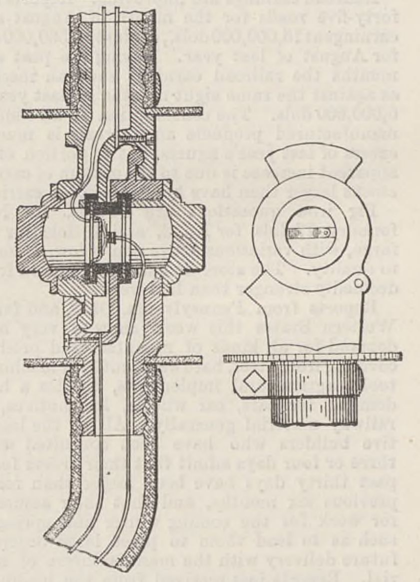

by the coupling, which acts as a shield and prevents the hand of the operator from coming in contact with the metallic portion of the coupling.

346,433. Machine for Winding Lead Tape upon Telegraph Cables, *Francis P. Duplain, Chicago, Ill.—Filed April* 6*th*, 1885.

Claim.—(1) The combination, in a machine for winding tape upon telegraph cables, of the revolving head *g*, a bobbin carrying the lead tape mounted thereon, the receptacle carrying the shellac, and the shellac wheel, over which the lead tape is guided, whereby the lead tape is wound on to the cable and shellaced at the same time, substantially as and for the purpose specified. (2) The combination, in a machine for covering telegraph cables, of a revolving

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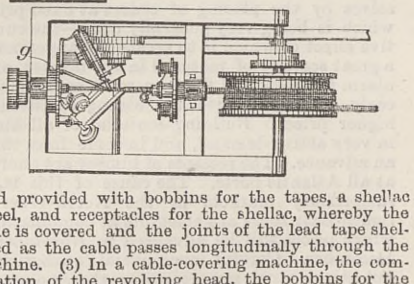

head provided with bobbins for the tapes, a shellac wheel, and receptacles for the shellac, whereby the cable is covered and the joints of the lead tape shellaced as the cable passes longitudinally through the machine. (3) In a cable-covering machine, the combination of the revolving head, the bobbins for the tape, and a receptacle for the shellac, which revolves around the core of conductors and shellacs the tape as it is wound on to the cable.

346,434. Steam Valve, *George H. Duthie, Muskegon, Mich.—Filed September* 1*st*, 1885.

Claim.—(1) The combination, with a hollow oscillating valve having the longitudinal openings G and F and the balance openings *g g*, arranged diametrically opposite thereto, and the exhaust chamber E, of the steam cylinder A, having the steam ports *a* and *b* and exhaust port *c* opening into said valve chamber and

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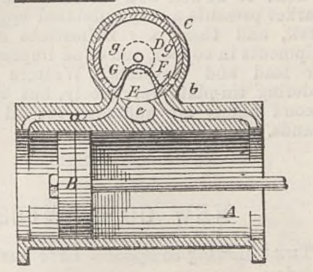

the piston and piston head. (2) The combination, with hollow oscillating valve open at both ends, having openings G and F and exhaust chamber E, cylinder A, having steam and exhaust ports *a*, *b*, and *c*, of the valve chamber C, having its interior corresponding to the shape of said valve, and having a steam supply pipe opening into one end thereof, substantially as and for the purpose set forth.