SCREW PROPELLER EFFICIENCY.

By Professor A. G. GREENHILL.

No. VII.

(81) *The balanced rudder.*—Putting $\theta=0$, we notice that a blade pivotted about an axis parallel to the edges, dividing the breadth in the ratio 5 to 11, that is dividing the breadth l into two parts of breadth $\frac{5}{16}l$ and $\frac{11}{16}l$, will be in neutral equilibrium when parallel to the stream; so that a balanced rudder pivotted in this manner will require no exertion at first to put it over to one side or the other.

This principle has been employed in the design of the so-called *balanced* rudder, but the practical results are not very satisfactory for a very simple reason; that is, if the rudder is very easily turned it has a correspondingly small turning effect on the ship—in fact, the couple required to hold the rudder over to any given angle is equal to the turning couple the rudder exerts on the ship.

(82) For towing a long narrow barge along a canal, the mast to which the tow-rope is attached should also divide the length from bow to stern in the ratio of 5 to 11, in order that the barge should steer as easily as possible.

Again, it may be asserted that the line of resultant thrust on the sails of a sailing vessel should cut the ship's medial plane in a point dividing the length from bow to stern in about the same ratio of 5 to 11, thus showing the necessity of the bowsprit and its sails in order to bring this centre of effort forward of the middle point. If, in consequence of too much sail aft and too little forward, the centre of effort of the sails falls behind this point, then the ship tends to run up into the wind, and carries "weather helm;" *vice versâ* if there is too much head sail.

Steamers have in general no bowsprit, and rarely therefore set any sail except on the forward masts, the small mizen masts being principally for the sake of appearance, or to set a little canvas if the steamer is required to heave-to from the machinery being disabled.

(83) As a preliminary to the complete mathematical investigation of the stream lines of the water past a screw propeller it will be necessary to determine the stream lines of liquid when a series of equidistant parallel blades are interposed in the liquid, but this has not been accomplished; afterwards we can determine any alteration due to the fact of the stream lines being wound as spirals on circular cylinders.

GENERAL CONCLUSIONS.

(84) In concluding these remarks on "Screw Propeller Efficiency," it will be interesting to make a comparison of them with similar conclusions made by Rankine, Froude, and other authorities.

In the "Trans." I.N.A., 1878, Froude says: "Speaking generally, one may say that it is in accordance with prevailing impressions respecting the theory of screw propulsion (1) that in seeking to obtain from the yielding material, water, a reaction adequate to a larger propulsive force, it tends to efficiency to employ as great as possible an effective area in the propeller; and (2) that it tends to give maximum efficiency to this area, whether it be large or small, if we make it operate on the water as squarely to the line of motion as possible, and therefore with as short a pitch as possible, in order to avoid a useless expenditure of power in giving rotational motion to the water acted on."

My conclusions in (9) and (10) are in agreement with this, except that on my theory the propulsion is obtained from the rotational motion imparted to the water, which can therefore never be totally suppressed, although it may be indefinitely diminished by increasing the revolutions and correspondingly diminishing the pitch.

In considering the modification of these principles when fluid friction is taken into account, Froude comes to the conclusion that a slip of about 12½ per cent. gives the most efficient result, as against about 8½ per cent. from (35) when the numerical errors are corrected.

(85) To attain this efficiency, Mr. E. H. Parker predicts, in his lecture on "Screw Propeller Efficiency," March 29th, 1886, that the marine engine of the future will be smaller and quicker running, driving a smaller propeller of finer pitch than is customary to use now; and the extraordinary results obtained from recent torpedo boats and the Whitehead torpedo, carrying out their ideas to their fullest development, certainly bear out the truth of his remarks.

The marine engine of the present, making at most 60 revolutions a minute, so that $n=1$, is too much on the lines of the old slow-moving paddle engines, and requires a large propeller with coarse pitch to develope its power.

(86) Again, in Mr. R. E. Froude's paper, "The Determination of the most Suitable Dimensions for Screw Propellers," "Trans." I.N.A., 1886, a series of five propositions are enunciated on p. 5; they are given as theoretically true, and I can show that my formulæ are in agreement with them.

Prop. i.: "The performance of any given screw, advancing at any given speed through the water, and turning at various numbers of revolutions per minute—in other words, working with various degrees of slip-ratio—may be represented by a diagram such as that in Fig. 18, when the abscissæ indicate values of slip ratio, the ordinates of the curve B B the corresponding thrust, and those of the curve A A the corresponding efficiency."

For, referring to (33, 34) and supposing u kept constant, then the thrust T and the efficiency e will vary as

$$\frac{s-\frac{k}{1+k}}{1-s} \text{ and } \frac{(1-s)\left(s-\frac{k}{1+k}\right)}{s}$$

respectively, when s denotes the slip ratio; indicating the shape of the curves A A and B B, which are consequently hyperbolas.

If fluid friction is neglected, then $k=0$, and the efficiency curve becomes the dotted straight line $a\,a$, the thrust curve being the hyperbola $b\,b$; it will then be noticed that the efficiency is unity when the thrust is zero.

Prop. ii.: "With given slip ratio, the thrust of a given screw varies as the square of the speed of advance through the water."

For, from (33)

$$T = 2\,\pi\,m\,(A^2-B^2)\,\frac{u^2}{p^2}\,\frac{s\,(1+k)-k}{1-s},$$

which varies as u^2, when s, p, &c., are kept constant.

Prop. iii.: "With given slip ratio and given speed of advance, with given design of screw and varying size, the thrust varies as the square of the dimension of the screw."

For keeping u and s constant, T varies as $(A^2-B^2)\div p^2$, which varies as the square of the linear dimension for a given design of screw.

Incidentally this proves that with the same pitch and variable diameter the thrust varies as A^2 nearly, that is as the *square* of the disc area.

Prop. iv.: "With given slip ratio and given design of screw, the efficiency is unaffected by variations of speed or of size of screw."

For the efficiency (34) does not depend on u or d, and is constant when s is constant.

Prop. v.: (consequent upon the four preceding). "A single diagram, such as that in Fig. 18, will represent the performance of any number of screws of given design but

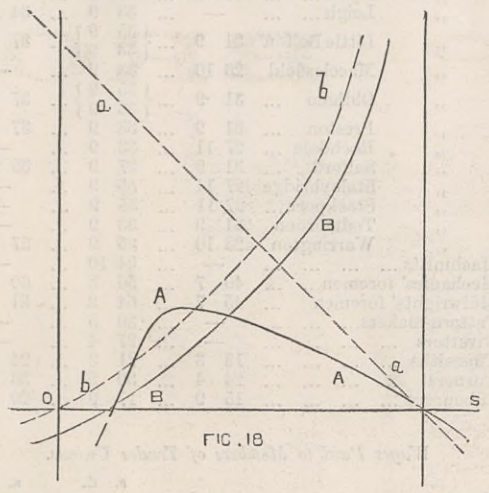


FIG. 18

of different sizes, advancing at any variety of speed through the water; if the ordinates of the thrust curves are taken to represent not thrust simply, but values of the expression $T \div d^2\,u^2$, when T = thrust, d = diameter of screw, and u = speed of advance through the water."

For, according to (33)

$$T \div d^2\,u^2 = 2\,\pi\,m\,\frac{A^2-B^2}{d^2\,p^2}\,\frac{s\,(1+k)-k}{1-s},$$

in which $(A^2-B^2)\div d^2\,p^2$ and k are constant for screws of given design but different sizes.

(87) In conclusion, making a comparison again between the theory of the screw propeller as given by Rankine and as developed in this paper, I have assumed that the propulsion is obtained from the rotation imparted to the water passing through the propeller, while Rankine takes the propulsion as equal and opposite to the backward momentum given to the water acted upon.

No doubt the true state of things is somewhere between these two hypotheses, and only experiment can give the answer.

As confirmatory of the slight amount of backward momentum observable in the wake of a screw steamer, the following remarks of Mr. W. Froude in the discussion on Rankine's paper on the "Mechanical Principles of the Action of Propellers," "Trans." I.N.A., 1865, p. 31, are adduced:—"You will find, if you will examine the current of a screw propeller sternward, that there is neither forward nor backward motion of those particles; but if the ship is aided by sails so that a part of the force which propels her, and which generates the wave, is not derived from the propeller solely, then the vessel will carry a current forward independent of the sternward motion got by the screw. On the other hand another vessel which has to do more work than is expended on her own resistance to the screw propeller will throw a sternward current," &c.

(88) Rankine starts with the axiom that in every propelling instrument the propulsive force is equal and opposite to the momentum generated per second; and this is undoubtedly true, if we only knew where to look for the momentum.

Take the case of a railway train, for instance. Where is the backward momentum to be found? The answer of course is, in the Earth. According to this modern dynamical notion there is no need for the long lever of Archimedes to move the Earth, as the motion of any body is sufficient to generate in the earth an equal and opposite momentum. Thus in propelling a punt by a pole, the backward momentum applied to the Earth is equal to the propelling force.

In the case of a paddle steamer a visible amount of momentum is generated on the surface of the water, and we equate this to the propulsion; but in the screw propeller, working under water, I have supposed in the present papers that the momentum is replaced by an increase of pressure in the water, which is gradually diffused through the ocean, this increase of pressure being analogous to the drag on the rails by the driving wheels of a locomotive.

On starting, the driving wheels occasionally slip; but this soon ceases, and when there is no slipping the efficiency of the wheels as propelling instruments is complete. The screw propeller, on the other hand, always slips, a certain amount of slip being necessary to produce the requisite thrust, and the efficiency of the propeller is correspondingly diminished.

It is necessary to examine carefully the principle of momentum in this manner, as a hasty application of it as an article of faith has led to erroneous theories of hydraulic propulsion, and costly experiments like that of the Waterwitch.

THE MALIGAKANDA RESERVOIR.

WE recently referred to two partial failures which had occurred to this important work constructed for the water service supply to the city of Colombo, Ceylon. When doing so, we stated that, in spite of the second occasion of failure reported, it was confidently expected that remedial measures in contemplation would secure the reservoir against further injury. We regret to learn, however, that this expectation has proved fallacious, and that on the occasion of refilling after those measures had been adopted, the masonry walling cracked with a loud report in so serious a manner as almost entirely to preclude the hope that the reservoir can ever be made to serve its full intended purpose. It is fortunately rare to hear of similar accidents occurring. When they do so, every endeavour should be made to ascertain their cause, in order to serve as warnings in cases of future design. The work at Maligakanda is one of great capacity and size, and its cost closely approached £50,000 sterling; the depth of water contained in it being 40ft., of which 30ft. stand above ground level. The reservoir is 191ft. square, and has a maximum capacity of 9,000,000 gallons. It is situate on a hill in the immediate neighbourhood of Colombo, and had it given way entirely before the water could be run off, the damage to life and property would probably have been most serious. As it was, the prior failures referred to warned the engineer in charge to watch the refilling with the greatest care, and before the breach could extend the water was rapidly run off by the means provided for that purpose.

It is needless to point out how essential it is that any work of this character in the vicinity of a large population should be constructed with even an excess of strength. Whenever such a location for service reservoirs can be avoided, its selection is certainly much to be deprecated; but in the instance under reference there does not appear to have been any choice possible. Now, so far as the design of this reservoir is concerned, there does not appear to have been any shortcoming as to insufficiency of constructive strength. The retaining walls, which are 35ft. high, have a thickness at their base of 21ft. 6in., and of 4ft. 6in. at the top water level. They are built of concrete blocks, and no accusation has been brought that their workmanship is in any way defective. When completed, the weight per square foot on the foundations of the walls was 31 cwt. to 37 cwt., and the hill has been carrying its own weight of 70 cwt. to 80 cwt. per square foot for centuries. The material, therefore, on which the work was founded must be held to have been fully adequate to the weight imposed. As regards the dimensions of the masonry walling, any engineer experienced in hydraulic work must admit that they afford ample margin of strength. Granted this, as also that the material built upon was of adequate solidity, to what cause must we look for this very regrettable failure? It is by obtaining a satisfactory answer to that query that we may hope to enlarge the experience which may enable greater security to be obtained in the future, and we have above pointed out the serious risk that must be run if that security cannot be fully attained in the case of town service reservoirs.

The accident is of too recent occurrence for any intelligence to have reached us of what may come to light from the official inquiry which will doubtless now be ordered; but we have before us the report of the resident engineer as to the causes to which he attributed the two earlier failures. That gentleman assigns the first of these to leakage through cracks in the concrete flooring affecting the material on which the walling was founded. It does not seem necessary to us that we should go further to establish a theory for the last failure which has occurred; the whole story may, we believe, be deduced from the first admission made. The Maligakanda hill is composed of a mass of laterite, or indurated clay, and no better substance could perhaps be found on which to rely than this "cabook," as it is locally termed, presuming it to be in a normal state. But, as sand is the most trustworthy foundation when in that condition, and the most untrustworthy when exposed to the action of running water, so does cabook lose its valuable property when it is subjected to damp. It then becomes as slippery as wet clay, and it is extremely possible that, having become so from the percolation through cracks—however apparently insignificant—in the concrete flooring of the reservoir, the masonry built upon it slipped just so much as it could do until it had effected its maximum limit of compression on the natural soil. If this slipping amounted to but ½in., it would suffice for the disruption of the wall, which has now twice occurred. There is, however, another question of importance for further consideration. The accident, it is suggested, may have arisen from subsidence of the material built upon, but there is every reason to think that within the sixteen months that have elapsed since the first failure, during which the foundations have had to bear their full loads, additional evidence of such subsidence would in that case have become apparent. But this has not been so, and we believe we must abandon the theory of subsidence as accounting either for the first or the third failures. But the intermediate failure was solely due to the development of cracks in the flooring of the reservoir. These were filled in, as we stated in our recent article upon this subject, with asphalte, and doubtless were thereby rendered watertight before the last filling with water was commenced. But the mischief was by that time done. The cabook upon which the wall was built had become saturated, and—if our proposition be sound—under the enormous pressure behind it, the wall slipped forward until the resistance of the solid and compressed material of the hill stayed further movement.

If our conjecture on the matter is rightly founded, it

may well be that the limit of injury at the particular spot where damage has now taken place has been reached; but it is, of course, even in that case quite impossible to say whether further developments of the same kind may not show themselves at other points on other occasions of filling, supposing repairs to be possible to admit of that being done. It is certain that this accident may prove useful in widening our experience, and we shall watch with interest the result to further inquiries to be made into its cause.

WAGES IN GREAT BRITAIN.

No. VIII.

Manchester—Manchester is the centre of the English cotton industry, but in the town itself of late years the tendency has been more and more in the direction of commerce, as, owing to the enhanced value of land, many mills and workshops have been removed to the outskirts and neighbouring towns and villages. In addition to cotton there are other important industries which in another community might be described as gigantic, among which are coal-mining, ironfounding, manufacture of machinery and tools in every branch, to the establishment and progress of which the proximity of Manchester to the rich coal-fields of Lancashire has greatly contributed. The chemical industries are also on a large scale. There being hardly any unimportant industries unrepresented, whole families often find employment, the father and sons finding work in the building, coal-mining, engineering, ironfounding, and other trades, while the rest of the family engage themselves in the cotton, silk, wool mills, &c. The relations between employer and employed have been improved, and much of the bitter feeling formerly existing has ceased, to the benefit of all concerned. Capital and labour are better organised, and partake of a character covering each particular trade throughout the county of Lancashire, instead of being merely local. One result of this is the necessitating of a longer period of deliberation and preparation before entering on a lock-out or strike, thus giving time for advice and mediation. The enlargement of the scope of trade organisations has brought an abler class of men into their management, which insures a larger and wider perception of the different views of any question in dispute. Boards of arbitration or conciliation composed equally of masters and men have been formed, who endeavour to fix a sliding scale of wages regulated by the price of the commodity or of the conditions of the trade, as certified by independently chosen auditors, who have access to the account books of the principal employers. The spread of the co-operative system has made the workpeople better acquainted with the conditions of trade from time to time, also with its adversities and difficulties, and therefore less disposed to arbitrarily conclude that an employer can always afford to maintain the rate of wages or advance them. The same results have followed from the investment by workmen in companies worked under the Limited Liability Acts, many of which are managed by working-men directors. These societies have in common with other trades suffered from the prevailing depression, and some have failed. A distinctive feature in the management of co-operative stores and limited liability companies in this neighbourhood is the principle of "one job to one man." At the commencement of the movement the rules were so drawn as to give a shareholder votes according to the number of shares held, but the system worked badly, and gradually broke down, and all the large concerns are now acting on the principle of equal voting power to each shareholder. A mill will be managed by a board of directors numbering from five to seven, all of whom are working men, such as bricklayers, brickmakers, cotton spinners, joiners, mechanics, &c. The salary of a director ranges from £3 to £5 a quarter, the chairman not receiving any addition. The secretary receives £4 a week, and the manager £5 10s. The auditors, who are elected by the shareholders for twelve months, receive each from £2 to £3 a quarter, according to the size of the mill. All the books of the company have to be gone through every quarter. The system has had great influence in educating the working men to become careful and critical examiners of the quarterly balance sheets of the various enterprises in which they are interested. In the district of Manchester, the system of arbitration has not always been successful, the operatives not always being satisfied with the awards. A trades union secretary of great experience gives his views of the working of arbitration as, "that however fair and honest a decision may be, it causes dissatisfaction, and the working classes, as a rule, have little faith in such settlements, and seem to have lost all confidence in the proceedings. If there were more of that forbearance which is necessarily brought into play, there would be fewer ruptures between capital and labour. Most of the strikes arise through not understanding the real state of the trade and the causes which require an arbitration on the rate of wages. I find that by educating the workmen in these matters they act reasonably, and with us hereafter strikes will be few and far between, to the benefit of all concerned." The general means provided for the safety of workpeople when at work are complete and efficient. In mines the effectual and rigid inspection by duly qualified inspectors is regarded as highly satisfactory. To this, and the warnings given when the dangerous areas of low pressure are indicated by the information received from the Meteorological Office, may be attributed the absence of serious loss of life in colliery accidents. In broad and general terms, it may be affirmed that, so far as possible, servants who have been injured in the course of their work are cared for as well as circumstances will permit by their employers, many of whom take a great deal of interest in the moral and physical well-being of their workpeople, and manifest it in a practical way. The habits of the working classes in this great industrial centre compare favourably with those operatives in any other part of the country, especially in industry, intelligence, and thrift.

Wages Paid per Week in Manchester and Surrounding District.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
General trades—			
Bricklayers	—	39 1	—
Carpenters	—	36 10	—
Masons 49½ hours.	—	33 5	—
Boilermakers	34 6	37 6	40 7
Brassfounders	30 5	35 0	35 5
Assistants	3 1	10 6	18 3
Coach Body-makers	28 6	32 5	36 6
,, Finishers	28 6	32 5	36 5
Smiths	28 6	32 5	38 5
Fitters	24 4	30 5	36 6
Hammermen	14 3	16 2	18 3
Horseshoers	18 3	21 6	24 4
Ironmoulders	35 9	37 9	37 9
,, Accrington	33 9	33 9	35 9
,, Blackburn	23 10	33 9	37 9
,, Bolton	31 9	35 9	37 9
,, Burnley	27 11	33 9	35 9
,, Bury	23 10	33 9	33 9
,, Darwen, Over	—	35 9	—
,, Haslingden	27 11	35 9 / 33 9	37 9
,, Heywood	33 9	35 9	35 9
,, Hyde	35 9	35 9	37 9
,, Leigh	—	33 9	34 10
,, Little Bolton	31 9	35 9 / 33 9	37 9
,, Macclesfield	23 10	33 9	—
,, Oldham	31 9	35 9 / 33 9	37 9
,, Preston	31 9	33 9	37 9
,, Rochdale	27 11	33 9	—
,, Salford	31 9	37 9	39 11
,, Staleybridge	27 11	35 9	—
,, Stockport	27 11	35 9	—
,, Todmorden	31 9	33 9	—
,, Warrington	23 10	35 9	37 9
Machinists	—	34 10	—
Mechanics' foremen	40 7	50 8	60 8
Millwrights' foremen	45 7	64 2	81 1
Pattern-makers	—	30 5	—
Rivetters	—	27 4	—
Tinsmiths	18 3	21 3	24 4
Turners	24 4	30 5	36 6
Labourers	15 9	17 9	20 3

Wages Paid to Members of Trades Unions.

		s. d.	s. d.
Carpenters	per hour	—	0 8
,, Burnley	,,	—	0 6¾
,, Buxton	,,	0 6½	0 7¼
,, Charlesworth	,,	0 6½	0 7
,, Chorley	,,	—	0 7½
,, Hyde	,,	0 4½	0 7½
,, Preston	,,	—	0 7½
,, Stockport	,,	—	0 7¾
,, Warrington	,,	—	0 7⅞
Stonemasons—			
Blackpool	,,	—	0 8
Bury	,,	—	0 8½
Darwen, Over—per week: Summer		—	35 0
Winter		—	30 0
Longridge	,,	—	0 8
Whitworth	,,	—	0 8
Amalgamated Society of Engineers—			
Dukinfield	per week	—	34 0
Glossop	,,	—	32 0
Preston	,,	—	28 0
Blacksmiths—			
Burnley	,,	—	28 0
Lancashire	,,	—	32 0
Ironfounders—			
Accrington	,,	32 0	36 0
Bury	,,	—	34 0
Rochdale	,,	27 0	36 0
Staleybridge	,,	—	36 0
Stockport	,,	—	36 0
Todmorden	,,	—	34 0
Warrington	,,	—	34 0
Steam engine makers—			
Blackburn	,,	—	32 0
Lancashire	,,	30 0	34 0

Average Wages Paid per Week of Fifty-four Hours in Foundries, Ironworks, and Machine Shops in Manchester and District.

	s. d.	s. d.
Foundries and ironworks—		
Angle-iron smiths	—	36 6
Apprentices	—	10 0
Blacksmiths	—	30 5
Strikers	16 6	21 0
Borers	—	31 6
Brassmoulders	—	32 6
Core-makers	—	26 0
Dressers	—	26 0
Drillers	19 0	22 6
Engine-fitters	27 6	32 0
Enginemen	—	23 0
Grinders	—	31 0
Holders-up	—	28 0
Ironmoulders	28 3	34 6
Machine-men	—	31 9
Millwrights	—	33 6
Painters	—	23 3
Pattern-makers	—	32 0
Planers	19 3	25 9
Platers	—	34 6
Rivetters	—	30 9
Screwers	18 6	22 6
Slotters	—	24 9
Turners	26 9	31 9
Labourers	—	17 6
Machine shops—		
Blacksmiths	—	27 6
Strikers	—	18 3
Brass moulders	—	31 0
Dressers	—	24 0
Drillers	—	17 3
Fitters	—	28 0
Grinders	—	27 9
Iron moulders	26 6	30 9
Machine men	—	19 0
Millwrights	—	29 10
Patternmakers	—	28 10
Planers	—	21 0
Slotters	—	21 3
Tinsmiths	—	29 3
Turners	—	26 4
Labourers	16 0	17 6

Wages Paid per Week of Fifty-four Hours in Messrs. Sharp, Stewart, and Co.'s Atlas Locomotive Works, Manchester.

	s. d.	s. d.
Angle ironsmiths	—	36 0
Borers	30 0	33 0
Brass moulders	—	32 0
Coppersmiths	28 0	30 0
Erectors	30 0	36 0
Fitters	30 0	36 0
Grinders	—	30 0
Helpers	—	18 0
Holders up	—	27 0
Ironmoulders	—	34 0
Painters	—	28 0
Patternmakers	—	34 0
Planers	21 0	26 0
Platers	—	34 0
Rivetters	—	30 0
Shapers	21 0	26 9
Slotters	21 0	26 0
Smiths	—	30 0
Strikers	—	19 0
Turners	30 0	33 0

All the above workmen, excepting painters and pattern-makers, are employed at piecework, by which means they earn an addition to their weekly wages of from 20 to 50 per cent. extra, the average increase for all classes being 18½ per cent. Apprentices begin at 4s. 4d. a week, and rise to a maximum of 15s. 0d. Foremen are paid a weekly rate of wages, and receive a bonus on the amount of work turned out of their respective shops. Overtime is paid for at the rate of time and a-quarter for the first two hours, and time and a-half for the remainder, the piecework price remaining unchanged.

Prices Paid per Week in a Cotton Mill at Bollington, Cheshire.

	s. d.	s. d.
Engineers	21 3	41 6
Mechanics	21 3	33 5

Average Wages paid per Week in a Large Cotton Mill at Bolton.

	s. d.
Engineers	36 6
Mechanics	32 11
Moulders	35 6

Average Wages Paid per Week in Cotton Mills in the district of Oldham.

	s. d.
Engineers	35 8

Wages Paid per Week by the Corporation of Manchester.

	s. d.	s. d.
Boilermakers	—	34 6
Engineers	40 7	50 8
Flaggers	—	30 5
Foremen—yard	—	50 8
Machinists	—	26 4
Mechanics	—	36 6
Patternmakers	—	34 0
Paviours	—	32 6
,, foremen	40 7	45 7
,, leading	—	34 6
Saw sharpeners	—	32 5
Smiths	—	30 5
Strikers	—	23 4
Tinsmiths	—	34 6
Wheelwrights	—	26 4
Labourers	—	20 3

Wages Paid per Week to Railway Employés in Manchester.

	s. d.
Locomotive Department—	
Boilermakers	33 5
Engine fitters	33 5
,, foremen	42 7
Foremen, general	55 9
Painters	29 5
Labourers	17 3
Engineers' Department—	
Permanent way inspector, per week	45 3
,, ,, sub. ,,	33 4
Platelayer foremen ,,	22 3
,, ,,	18 3
Telegraph linesmen	30 5
Carriage Department—	
Carriage builders	30 5
,, ,, foremen	55 9
,, smiths	30 5
,, ,, strikers	24 4
Horse shoers	34 6
Assistants	30 5
Labourers	18 3

Average Wages Paid per Week for the Manufacture of Iron in Manchester and district.

	s. d.
Ball furnacemen	48 4
Forge rollers	48 6
Galvanisers	38 9
Hammermen	62 6
Mechanics	29 6
Puddlers	46 4
Wire drawers	43 4
Wire rollers	114 6
Labourers	19 3

The following are rules drawn up by a joint committee of the Amalgamated Society of Engineers and Steam Engine Makers' Society for Oldham and district. The annexed list are the minimum rates of wages to be received by members of the two societies working in the above districts by—Fitters, millwrights, and turners in engine and tool shops, 32s. 5d. per week; for fitters and millwrights working out of shop, 32s. 5d. per week, and district allowances as per rule; for pattern makers in all shops, 33s. 5d. per week; for smiths, 32s. 5d. per week; for fitters, mill joiners, mill mechanics, and turners, 31s. 11d. per week; for fitters and turners in gas meter shops, 31s. 5d. per week; all time over 54 hours in meter shops to be paid at the rate of not less than time and a-quarter.

In all factories and mills where mill mechanics are employed, and where more than 54 hours are required to constitute a week's work all the time in excess of 54 hours must be reckoned as overtime, and paid for at no less a rate than time and a-quarter. In engine, millwright, and tool shops, all time over 54 hours must be paid time and a-quarter, time and a-half, double time and otherwise, as per district rules. That in the case of all members who are engaged permanently at a factory or mill, and who are required to help or take the place of contractors' men engaged on engine or millwright work

TYPICAL MASONRY AND EARTHWORK DAMS OF THE WORLD.

(*For description see page* 208.)

FIG. 10.

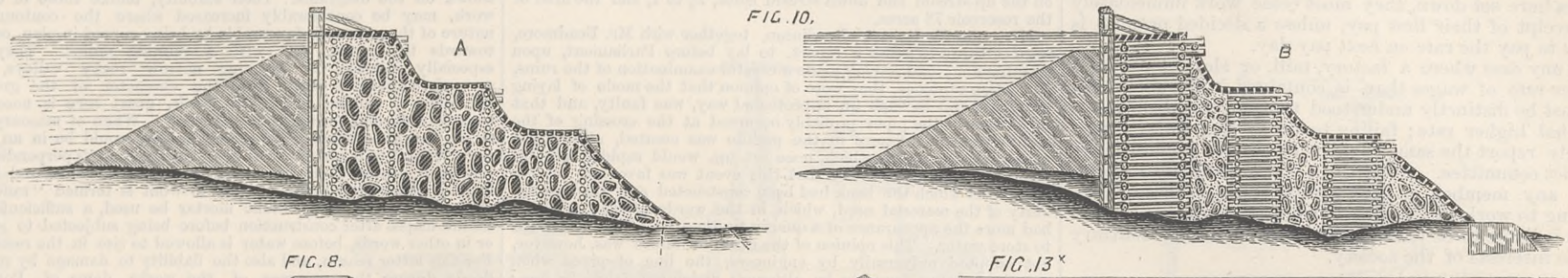


FIG. 8.

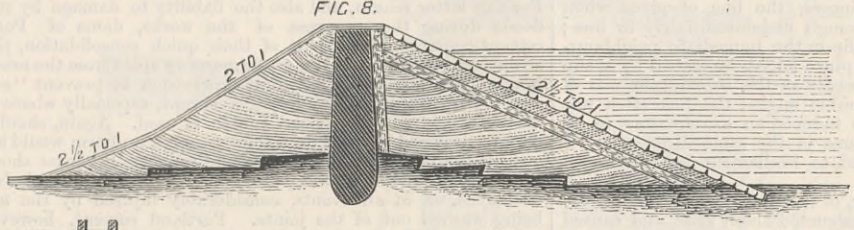


FIG. 13ˣ

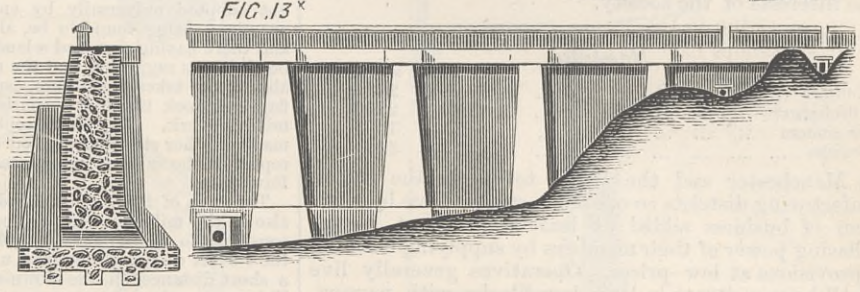


FIG. 19.

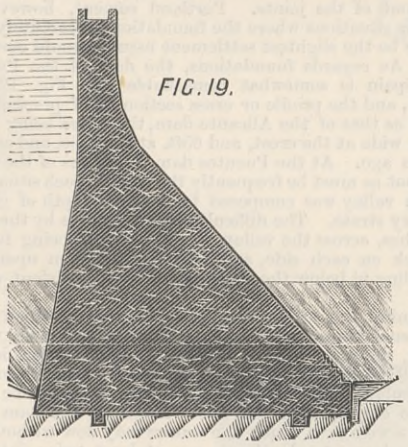


FIG. 1.

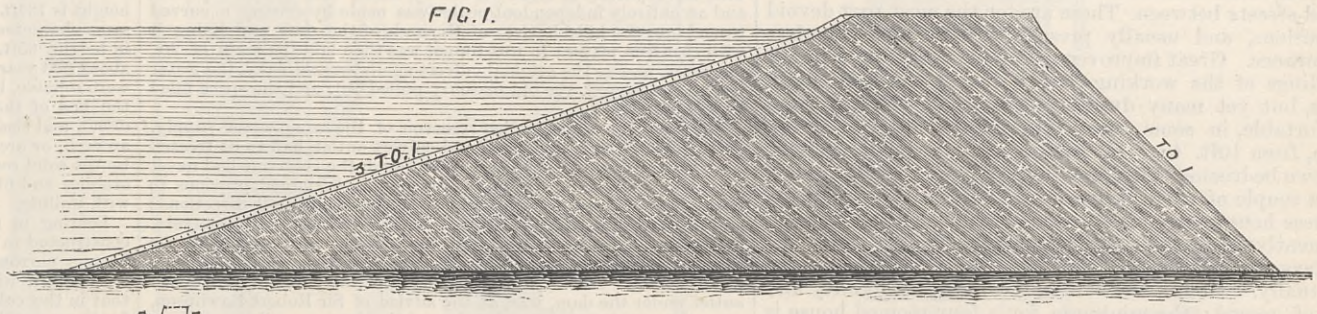
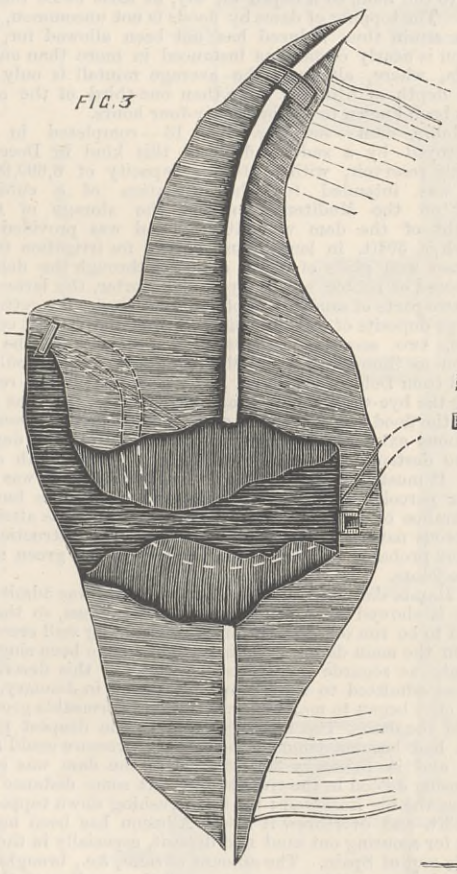


FIG. 3



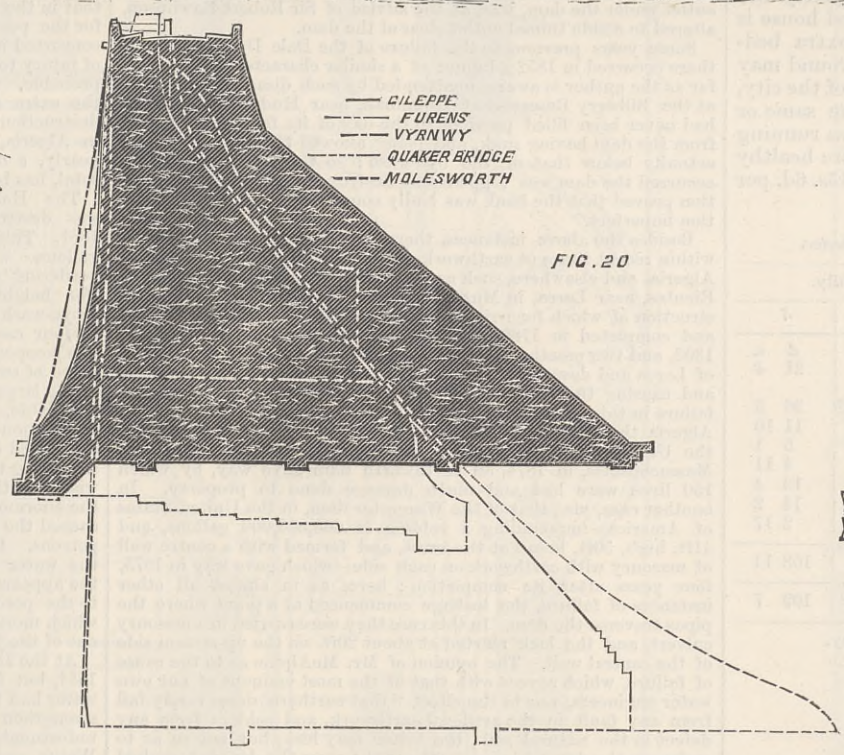


FIG. 20

FIG. 13

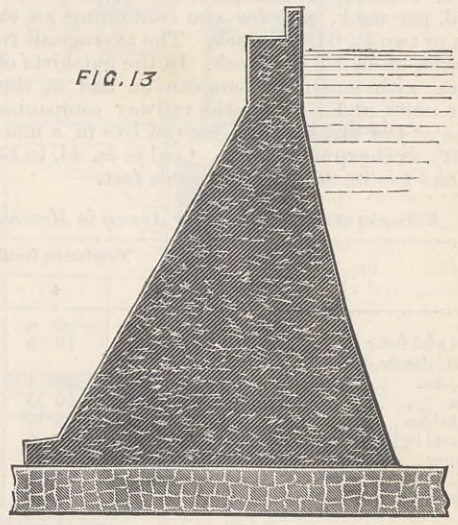


FIG. 2

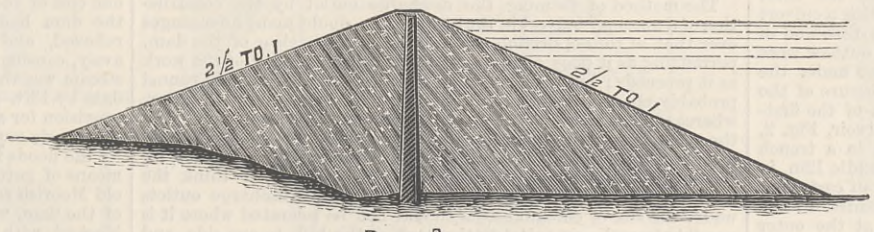


FIG. 15

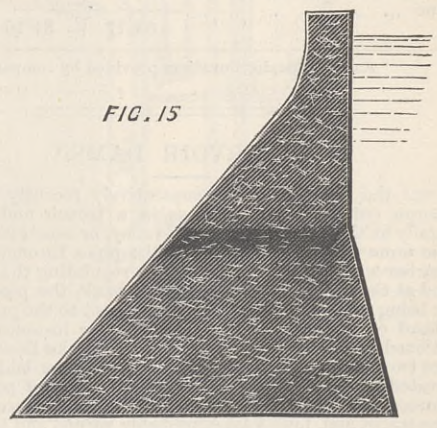
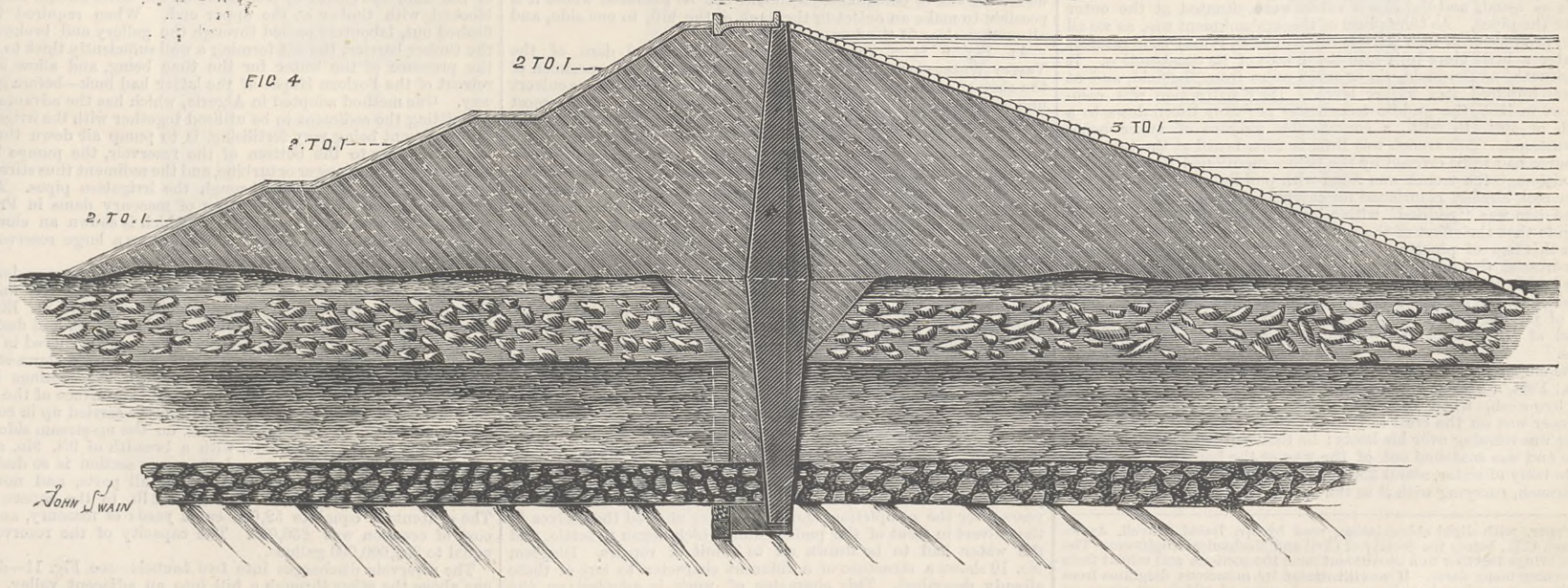


FIG 4



in such mill it must be distinctly understood that they must receive the same rates of overtime, viz., time and a-quarter, time and a-half, and double time, as per millwrights' rules. Should any member of the above-named societies start in any firm, and fail to get the rate of wages here set down, they must cease work immediately on receipt of their first pay, unless a decided promise is made to pay the rate on next pay day.

In any case where a factory, mill, or shop is paying a higher rate of wages than is contained in the above list, it must be distinctly understood that our members are to get that higher rate; failing to do so they must immediately report the same to their respective secretaries or district committee. After these rules come into operation, any member of the within-named societies continuing to work at less rates than those contained in the rules is liable to be proceeded against as acting contrary to the interests of the society.

Average Wages Paid per Week in Coal Mining in the District of Manchester.

	s.	d.
Colliers	26	0
Dischargers	20	0
Engineers	32	0
Smiths	29	0

In Manchester and the larger towns in the cotton manufacturing districts co-operative stores have by their system of business added at least 5 per cent. to the purchasing power of their members by supplying clothing and provisions at low prices. Operatives generally live in small houses situate in long, low blocks, with narrow-paved streets between. These are for the most part devoid of gardens, and usually present a bare and cheerless appearance. Great improvements have taken place in the dwellings of the working-classes during the last thirty years, but yet many dwellings are small and far from comfortable, in some cases containing only one living room, from 10ft. to 15ft. square, with a small scullery and two bedrooms. The larger houses have a small kitchen and a couple of extra bedrooms. The sanitary condition of these houses is generally good, as they are carefully and frequently inspected by competent officials, and the sanitary authorities in the main do their work very effectually. House rents vary according to locality and size of rooms; the minimum for a four-roomed house is 2s. 7d. per week, and for one containing an extra bedroom or two 4s. 6d. per week. The average all round may be taken at 4s. 1d. per week. In the outskirts of the city, houses with small gardens can be had at the same or lower rents, and through the railway companies running trains at low fares, operatives can live in a more healthy locality as cheap as in town. Coal is 9s. 4d. to 13s. 6d. per ton, and gas 2s. 8d. per 1000 cubic feet.

Examples of Cost of Living per Annum in Manchester.

	Number in family. 4	4	7
	£ s.	£ s.	£ s.
Bread and flour	10 5		21 4
Butter, cheese, coffee, milk, sugar, tea, &c.	25 1		36 5
Meats	10 15		11 10
Vegetables	46 3	3 16	5 1
Fuel and light	3 18	3 5	4 11
Clothing	*4 0	8 15	13 4
Rent	11 15	13 0	14 2
Incidentals	—	5 4	2 17
Total	65 16	80 1	108 14
Income	65 17	84 10	109 7

* Railway employé uniform provided by company.

RESERVOIR DAMS.[1]

It was the practice until comparatively recently to make the discharge outlet by laying pipes in a trench under the dam, generally at the lowest point in the valley, or constructing a culvert in the same position and carrying the pipes through this, and in the earlier works the valves or sluices regulating the outflow were placed at the tail of the down-stream bank, the pipes under the bank being consequently at all times subject to the pressure of the full head of the water in the reservoir. An instance of the first-mentioned method is afforded by the Dale Dyke Reservoir, Fig. 2, where two lines of pipes of 18in. diameter were laid in a trench excavated in the rock and resting upon a bed of puddle 12in. in thickness, and surrounded by puddle; the pipes were of cast iron, of the spigot and faucet type, probably yarned and leaded at the joints as usual, and the sluice valves were situated at the outer end of the pipes. As the failure of this embankment was, as we all know, productive of such terrible consequences, it may be of interest to enter a little more fully into the details of its construction. It was situated at Bradfield, six or seven miles from Sheffield, and at several hundred feet higher level. Its construction was commenced in 1858, the puddle trench was probably taken down to a depth of 40ft. to 50ft., a considerable amount of water being encountered. This trench was 15ft. to 20ft. broad at the top, and of course had to be crossed by the before-mentioned line of pipes, and although the trench was filled with puddle and the gullet cut in the rock already mentioned for carrying the pipes under the site of the dam was "padded" with a layer of 12in. of puddle, we can imagine that the effect of the weight of the puddle wall and bank upon this line of pipes would be very different at the point where they crossed the puddle trench to what it would be where they were laid in the rock gullet and partly protected from pressure by the sides of the latter. At the trench crossing there would be a bed of puddle 50ft. in thickness beneath the pipe, in the gullet a bed of 1ft. in thickness. So much as regards the laying of the pipes.

The embankment had scarcely been completed when, on March 11th, 1864, a storm of rain came on and nearly filled it up to the bye-wash, when the bank began slowly to subside. The engineer was on the crest at the very time and remained until the water was running over his boots; he then rushed down the other slope and was snatched out of the way as the bank burst, and the whole body of water, about 250,000,000 gallons, rushed out through the trench, carrying with it in the course of about twenty minutes 92,000 cubic yards, or, say, one fourth of the total mass of earthwork, causing the death of 250 human beings, not to mention cattle, and destruction of factories, dwellings, and bridges, denuding the rock of its surface soil, and, as it were, obliterating all the land marks in its course. The greatest depth of the bank from ground level to crest was 95ft., the top width 12ft., and the slopes, both on the up-stream and down-stream sides, 2½ to 1, and the area of the reservoir 78 acres.

Mr.—now Sir Robert—Rawlinson, together with Mr. Beadmore, were called in to make a report, to lay before Parliament, upon this disaster; and having made a careful examination of the ruins, and taken evidence, they were of opinion that the mode of laying the pipes, and in such an unprotected way, was faulty, and that subsidence of the pipes probably occurred at the crossing of the puddle trench; a fissure in the puddle was created, affording a a creep for the water, which, once set up, would rapidly increase the breach by scour; and that this event was favoured by the manner in which the bank had been constructed and the unsuitability of the material used, which, in the words of one engineer, had more the appearance of a quarry tip than of a bank intended to store water. This opinion of the cause of failure was, however, not adopted universally by engineers, the line of pipes when examined being found to be, although disjointed, fairly in line; and there having occurred a landslip in the immediate neighbourbood, it was suggested that the rupture might be caused by a slip also having taken place here, especially as the substratum was of flagstone rock tilted at a considerable angle; the formation was millstone grit. This catastrophe induced an examination to be made of other storage reservoir dams in the same district, and a report on the subject was presented to Parliament by Sir Robert Rawlinson.

The dam of Stubden Reservoir, of the Bradford water supply, also on the millstone grit, was constructed about 1859, and caused considerable anxiety for a length of time, as leakage occurred in the culvert carrying the pipes, under the embankment at a point a short distance on the down-stream side of the puddle trench. This was repaired to some extent by lining with cast iron plates; and an entirely independent outlet was made by driving a curved tunnel into the hillside clear of the ends of the dam and lining it with cast iron plates; in this tunnel was then laid the main of 2ft. diameter, and as the original culvert again became leaky, the water had to be lowered, the old masonry pulled out, and the space filled in with puddle.

The Leeming compensation reservoir of the same water supply, with a dam of 50ft. in height, and culvert outlet, had to be treated somewhat in the same manner, as although the reservoir had never been filled with water, in 1875, when it was examined previous to filling, it was found that the culvert was cracked in all directions; and it was deemed best to fill it up with Portland cement concrete, and drive a tunnel outlet through the hill side, as described in the case of the Stubden Reservoir. The Leeshaw dam, which was being constructed at that time upon the same lines, viz., with culvert outlet under the dam, was, at the advice of Sir Robert Rawlinson, altered to a side tunnel outlet clear of the dam.

Some years previous to the failure of the Dale Dyke Reservoir there occurred in 1852 a failure of a similar character—though, as far as the author is aware, unattended by such disastrous results—at the Bilberry Reservoir at Holmfirth, near Huddersfield, which had never been filled previous to the day of its failure, and arose from the dam having sunk, and being allowed to remain at a level actually below that of the bye-wash; so that when the storm occurred the dam was topped and destroyed. An after examination proved that the bank was badly constructed and the foundation imperfect.

Besides the above instances, there have been numerous failures within recent times of earthwork dams in Spain, the United States, Algeria, and elsewhere, such as that which occurred at Estrecho de Rientes, near Lorca, in Murcia, where a dam 150ft. high, the construction of which for irrigation purposes was commenced in 1755 and completed in 1789, was filled for the first time in February, 1802, and two months later gave way, destroying part of the town of Lorca and devastating a large tract of the most fertile country, and causing the death of 600 people. The immediate cause of failure in this case the author has been unable to ascertain. In Algeria the Sig and Tlélat dams were destroyed in 1865, and in the United States of America, at Williamsberg, Hampshire Co., Massachusetts, in 1874, an earthworth dam gave way, by which 150 lives were lost and much damage done to property. In another case, viz., that of the Worcester dam, in the United States of America—impounding a volume of 663,330,000 gallons, and 41ft. high, 50ft. broad at the crest, and formed with a centre wall of masonry with earthwork on each side—which gave way in 1875, four years after its completion; here, as in almost all other instances of failure, the leakage commenced at a point where the pipes traverse the dam. In this case they were carried in a masonry culvert, and the leak started at about 20ft. on the up-stream side of the central wall. The opinion of Mr. McAlpine as to the cause of failure, which agrees with that of the most eminent of our own water engineers, was to the effect "that earthern dams rarely fail from any fault in the artificial earthwork, and seldom from any defect in the natural soil; the latter may leak, but not so as to endanger the dam; in nine-tenths of the cases the dam is breached along the line of the water outlet passages."

The method of forming the discharge outlet by the construction of a masonry culvert in the open has no doubt many advantages over that of tunnel driving through the hill side clear of the dam, permitting as it does of an easy inspection and control of the work as it proceeds; but a slight leakage in the instance of a side tunnel probably means nothing more than the waste of so much water, whereas in the case of the culvert traversing the site of the bank, the same amount or less, imperils the stability of the bank, and in ninety-nine cases out of a hundred would, if not attended to, sooner or later be the cause of its destruction. I think the majority will therefore agree that the method of discharge outlets under the site of embankments should not be tolerated where it is possible to make an outlet in the flank of the hill, to one side, and altogether clear of the dam.

At Fig. 9 is a diagram of the Roundwood dam of the Vartry Waterworks, supplying Dublin, which is a fair specimen of the class of earthwork dam with the outlet pipes carried in a culvert under the embankment, and which perhaps is one of the most favourable specimens of this method of construction, as the inlet valves are on the up-stream of the dam, and consequently when necessary the water can be cut off from the length of pipes traversing the dam. A short description will be given. This dam is 66ft. high at the deepest point, and 28ft. wide at the crest, having to carry a public road. The slope on the inner face is 3 to 1, and on the outer 2½ to 1. The bye-wash is 6ft. below the crest, which is about the average difference. The storage capacity of the reservoir is 2,400,000,000 gallons, or sufficient for 200 days' supply to the city. The puddle wall is 6ft. wide at the top and 18ft. at ground level, the bottom of the puddle trench about 40ft. below the surface of the ground. The culvert was formed by cutting a gullet 14ft. wide with nearly vertical sides through the rock, and covering it with a semicircular arch 4ft. in thickness. Through this tunnel are laid a 33in. and 48in. main; the former for the water supply, and the latter for scouring or for emptying the reservoir on an emergency. There is a plugging of brickwork in cement under the centre of the dam in the line of the puddle wall, and then stop walls built at the end of the plugging, projecting 25ft. beyond the sides of the culvert and 8ft. above, the space between them being filled up with cement concrete tied into the rock, and on this the puddle wall rests. This bank, like almost all others pierced by outlet pipes or culverts, was not destined to be perfect. In 1867, four years after the completion, spurts of water showed themselves in the culvert in front of the puddle wall, which began to settle, and the water had to be drawn off to admit of repairs. Diagram No. 10 shows a structure of a different character to any of these already described. This character of work is adopted on the North Poudre Irrigation Canal in N.E. Colorado. Timber is there plentiful, and a dam of this character can be rapidly constructed, although probably not very durable owing to liability to decay of timber. That represented is about 25ft. high.

The author has now concluded the consideration of earthwork dams, and proposes making a few remarks upon those of masonry or concrete, with references to some of the most important, as shown on the diagrams. Their stability, unlike those of earthwork, may be considerably increased where the contour and nature of the ground is favourable by being curved in plan, convex towards the water, and with a suitable radius. They are especially suitable for blocking narrow rocky valleys, and as such situations must, from the character of the ground, be liable to sudden and high floods, great care is necessary to make sufficient provision for overflow. When of masonry, the stones should be bonded, not merely as they would be in an ordinary vertical wall where the direction of the stress is perpendicular, but each course should be knit in with that above and below it in a somewhat similar manner to what is termed "random" work; and lastly, if hydraulic mortar be used, a sufficient time should elapse after construction before being subjected to strain, or in other words, before water is allowed to rise in the reservoir. For this latter reason, and also the liability to damage by sudden floods during the progress of the works, dams of Portland cement concrete, on account of their quick consolidation, possess advantages over those of hydraulic masonry apart from the necessity in the latter instance of constant supervision to prevent "scamping" by leaving chinks and spaces vacant, especially where large masses of stone or Cyclopean rubble is used. Again, should the dam be drowned by flood during its erection, no harm would accrue were it composed of Portland cement concrete, whereas should it be of hydraulic mortar masonry the wall would probably be destroyed, or, at all events, considerably injured by the mortar being washed out of the joints. Portland cement, however, is only suitable for situations where the foundation is absolutely firm, as should there be the slightest settlement fissures would certainly be produced. As regards foundations, the dam of the Puentes Reservoir in Spain is somewhat remarkable—see Fig. 12. Its height is 164ft., and the profile or cross section is of precisely the same character as that of the Alicante dam, the latter being 135ft. in height, 65ft. wide at the crest, and 65ft. at the base, and erected about 300 years ago. At the Puentes dam the flanks of the valley were reliable, but as must be frequently the case in such situations, the bed of the valley was composed to a great depth of gravel, *débris*, and shaky strata. The difficulty was overcome by throwing an arch, or arches, across the valley, the abutments being formed by the solid rock on each side, and building the dam upon this arching and filling in below the latter down to a sufficient depth with walling.

Bearing in mind the sudden and great floods to which dams constructed in such situations must be subjected, and if the valley be very narrow, the probability that sufficient space at the side for a bye-wash will be difficult to obtain, it would seem reasonable that in the calculation for their section allowance should be made for the possible condition of the whole length of the dam being converted into a weir over which the waters may flow without risk of injury to the dam, to a depth of, say, at least twice that ever probable. The topping of dams by floods is not uncommon, and if the extra strain thus induced has not been allowed for, their destruction is nearly certain, as instanced in more than one case in Algeria, where, although the average rainfall is only 15in. yearly, a depth of 6¼in., or more than one-third of the annual total, has been known to fall in twenty-four hours.

The Habra dam—see Fig. No. 13—completed in 1871, was destroyed by a sudden flood of this kind in December, 1881. This reservoir, with a storage capacity of 6,600,000,000 gallons, was intended for the irrigation of a cultivated bordering on the Mediterranean and the storage of floods. The height of the dam was 116·7ft., and was provided with a bye-wash of 394ft. in length, and outlets for irrigation formed by four cast iron pipes of 31½in. diameter through the dam. It was composed of rubble set in hydraulic mortar, the latter composed of two parts of sand to one of hydraulic lime. For getting rid of the large deposits of sand to which all reservoirs in that country are liable, two scouring outlets were provided of the same description as those in the old Moorish dams. The profile was calculated from Delocre's formula, and was correct in this respect supposing the bye-wash to have been sufficient; but as it was otherwise, and the flood swept over the crest to the depth of about 3ft., the enormous extra strain thus induced overthrew the dam and caused the destruction of several villages and the death of 209 persons. It must be mentioned that when the reservoir was filling the water percolated through the masonry, giving the face wall the appearance of a huge filter, which at the time was attributed to the porous nature of the sandstone used in construction, but which more probably was due to the washing of the green mortar out of the joints.

At the Hamiz dam, also in Algeria, the water was admitted in 1884, but it showed immediately signs of weakness, so that the water had to be run out and an immense retaining wall erected to strengthen the main dam. Algeria seems to have been singularly unfortunate as regards the success of works of this description. Water was admitted to the Cheurfas Reservoir in January, 1885, and it at once began to make its way through permeable ground at one end of the dam. The flushing sluice in the deepest part of the dam had become jammed, so that the pressure could not be relieved, and in February 30ft. length of the dam was carried away, causing a flood in the river below. At some distance down stream was the Sig Reservoir; the flood rushing down topped this dam by 18ft. and overthrew it also. Allusion has been made to provision for scouring out sand and deposit, especially in the dams of Algeria and of Spain. The amount of sand, &c., brought down by the floods is something enormous, and the question of the best means of getting rid of it has occupied much attention. In the old Moorish reservoirs the flushing gallery, piercing the lower part of the dam, was closed by iron doors on the down-stream face and blocked with timber at the upper end. When required to be flushed out, labourers passed through the gallery and broke down the timber barrier, the silt forming a wall sufficiently thick to resist the pressure of the water for the time being, and allow of the retreat of the Forlorn Hope—if the latter had luck—before giving way. One method adopted in Algeria, which has the advantage of permitting the sediment to be utilised together with the irrigation, this sediment being very fertilising, is to pump air down through hose extending to the bottom of the reservoir, the pumps being actuated by steam power or turbine, and the sediment thus stirred up and run off with the water through the irrigation pipes. As an example of one of the early types of masonry dams in France, reference may be made to Fig. 13, on which is shown an elevation and cross section of the Lampy dam, forming a large reservoir for feeding the Languedoc Canal.

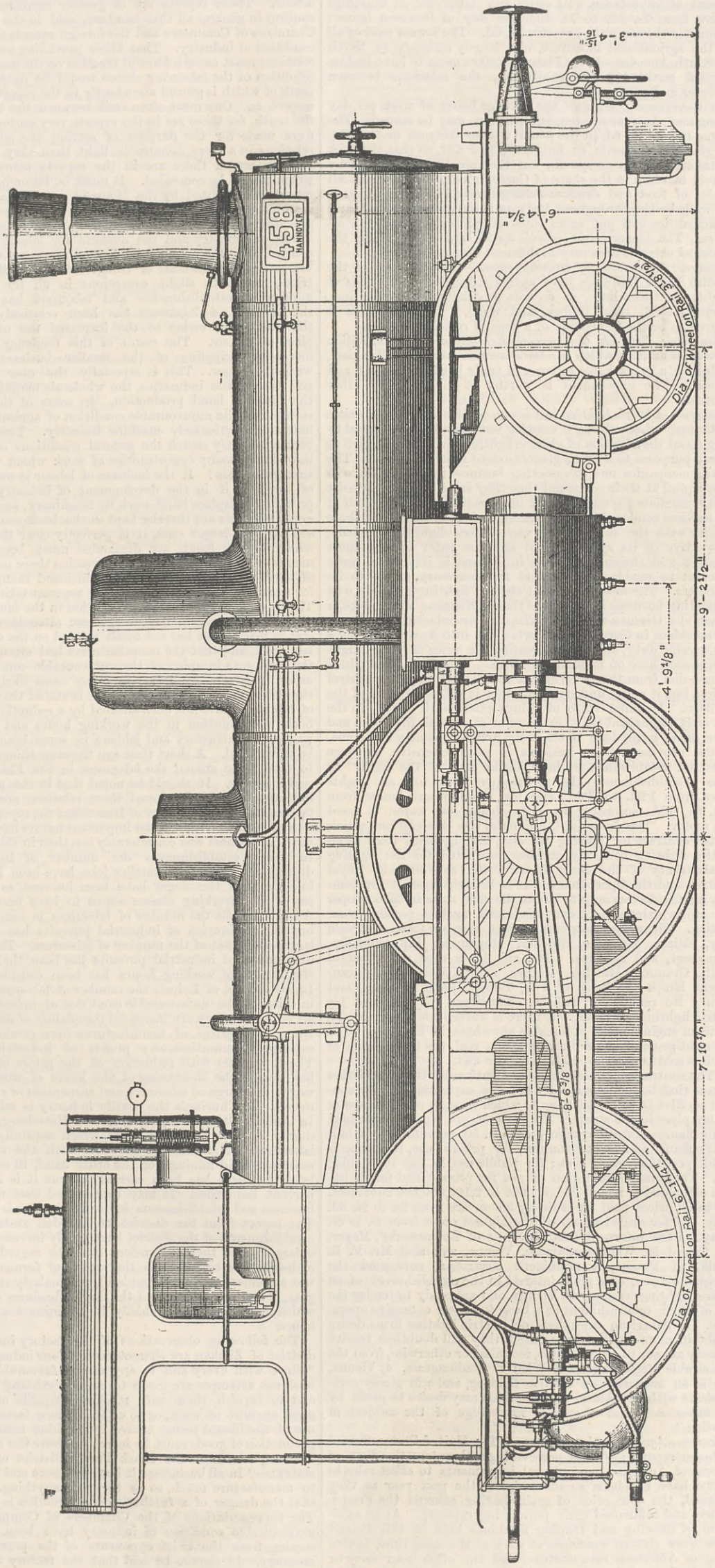
I will now refer to some of the most notable masonry dams in existence, commencing with France, where perhaps the finest is that known as the Furens, in connection with the St. Etienne Waterworks, constructed between the years 1859-66, and designed by the engineers Graiff and Grandchamps. It is curved in plan, struck with a radius of 828ft. from a centre on the down-stream side, and founded upon compact granite, the footings being carried down to a depth of 3ft. 3in. below the surface of the rock. It is of rubble masonry in hydraulic mortar carried up in courses of 5ft. in depth. The height is 170ft. on the up-stream side, and 184ft. high on the lower side, with a breadth of 9ft. 8in. at the crest and 110ft. at the base, and the cross section is so designed that the pressure is nearly constant in all parts, and nowhere exceeds 93 lb. to the square inch—13,392 lb. to the square foot. The contents is equal to 52,000 cubic yards of masonry, and the cost of erection was £36,080. The capacity of the reservoir is equal to 352,000,000 gallons.

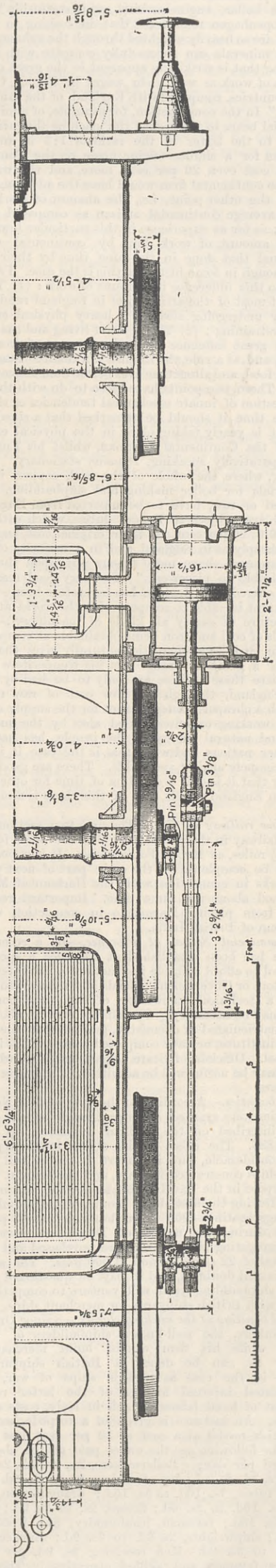
The reservoir discharges into two tunnels—see Fig. 11—driven one above the other through a hill into an adjacent valley. The lower tunnel contains three cast iron pipes, with a masonry stopping

[1] Paper, with slight abbreviation, read by Mr. David Gravell, Assoc. M. Inst. C.E., before the Society of Civil and Mechanical Engineers. The paper brings together in a convenient form the sections and salient facts concerning many dams. It was illustrated by numerous diagrams from which our engravings have been prepared, some of which are given on page 187.

COMPOUND PASSENGER LOCOMOTIVE, VON BORRIES SYSTEM, HANOVER RAILROAD, GERMANY.

(For description see page 210.)





ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

Denmark—Labour in Europe. — The information to be obtained from this country is exceedingly meagre compared with that from the great industrial centres of France, Germany, &c., two-thirds of the population of Denmark being engaged in agriculture or maritime pursuits, and the factories being limited to a few chiefly producing textile fabrics. One of the partners in an extensive boiler, engine-making, and steamship building works in Copenhagen remarks, "that in looking to see how nations that are so heavily weighted through the enhanced prices of coal and minerals can successfully compete with England, the first thing that is strikingly apparent is the great difference in the hours of work as well as in wages in France, Germany, and other countries, compared with England, of the same classes of workmen." In the construction, for example, of a mill engine, if the material bears to the cost of the machine the ratio of 2:3, with wages to the latter in the ratio of 1:3 in an English machine, then for a similar engine made on the Continent, if the material cost even 20 per cent. more, and the wages cost only half, the continental firm would have the advantage. This brings us to the other point, *i.e.*, the amount of work turned out by the average continental artisan as compared with the English one; as far as experience in this particular branch goes, the average amount of work done by continental workmen does not equal that done in the same time by their English brethren, though in some instances this is the case. Two causes contribute to this difference in amount of work: (1) The early training that most of the artisans get in England renders them more fit for undergoing steadily a heavy physical endurance without overstraining; (2) The style of living and the quantity of food have great influence upon the amount of work which can be done, and, as a rule, the English workman consumes much more animal food, and altogether lives better than the continental workman. These two points have more to do with the matter than the question of innate mechanical tendencies or skill; but at the same time it should be remarked that a steady visible improvement is yearly taking place in the physical endurance and skill of the Continental workman, whilst his English colleague, comparatively speaking, remains stationary. Even in this country, where the whole of the coal, copper, iron, and steel, materials for boiler making and shipbuilding, whether manufactured or raw, have to be imported from England and Sweden, and are subject to import duties, which with freight adds from 10 to 20 per cent. on their original cost, engines can be built as cheaply as in England, and in a majority of cases—to please customers—have more labour put upon them. The same is applicable to piecework." Two very good reasons may perhaps be offered why England has heretofore been—and still to a large extent is—able to compete with the world at large in the manufacture of nearly all kinds of machinery:—(1) The raw materials of coal and iron being obtainable at comparatively small cost in such large quantities naturally gives the English manufacturer a great advantage over his competitors in other countries where these articles are only to be had by importation; (2) England, through the low cost of raw materials, together with a cheaper money market for the supply of vested capital and working expenses, aided also by the mechanical businesses and natural energy of the people, has had a long start of other nations, and when that is the case it is a hard struggle to compete against such odds. There are good grounds for assuming that it is only a question of time for other nations to press upon England's heels, and of this there is almost daily evidence.

India—New railway in Goa.—The first two sections of the Marmagao Railway in the province of Goa are open for a distance of 37½ miles, as far as Fauvordene. It is expected that the line will be completed in the early part of next year, and that the works in connection with the Harbour of Marmagao will be finished about the same time. Important results are anticipated from placing Marmagao in connection with the railway system of British India.

Italy—Commercial School at Florence.—By a recent Royal decree there has been established at Florence a special commercial school to afford suitable instruction to all intending to become Custom or Government officials and manufacturers, and for whom a technical knowledge of trade and commercial geography may be necessary. Candidates for the above school must have matriculated in chemistry, graduated at the Lyceum or technical institute, or have completed their studies in a commercial school. Officials of State departments to whom such instruction may be useful will be admitted. The course of study lasts two years.

Shipping bounties.—According to the law of 5th November, 1885, bounties were granted on ships though bought abroad if they were inscribed on the harbour registers up to 31st December, 1886. The effect of the above temporary bounty has been considerable, but in future bounties will only be granted on ships constructed in Italy, and the amount set down for that purpose in the Naval Estimates for the current year is £152,000. During the first eleven months of 1886 only eleven steamers, aggregating 4200 tons burthen, were purchased abroad, but during the month of December eleven other steamers, aggregating 16,800 tons, were purchased and inserted, making a total of 22 steamers and 21,000 tons. The success of the system is still doubtful, and it may be questioned whether any Italian shipbuilding yard will venture to compete in spite of bounties with British shipyards for merchant ships.

Wages and taxation of the working classes.—Signor Orlando, of Orlando Brothers, the well-known shipbuilders of Leghorn, states that while his firm cannot build merchant ships as cheaply as can be done in British shipyards, that the reverse is the case as regards ships of war, because the complicated internal fittings of the latter require a great amount of hand labour, which in Italy costs so much less in wages. An instance is given of a torpedo boat copied from a British model at a cost of 30 per cent. less than the original. The following are the wages paid at the above shipbuilding yard per day:—Boilermakers, 2s., 2s. 3d., 2s. 6d. and 3s. 9d.; boys, 3d. to 8d.; brassfounders, 2s. to 2s. 6d.; coppersmiths, for tubes, 1s. 10d. to 5s. 10d.;[1] draughtsmen, to copy drawings, 1s. 10d. to 2s. 6d.; fitters, 2s. to 3s. 9d.; foremen, 4s. 2d. to 5s. 10d.; foreman, ironfoundry, 8s.; ironfounders, 2s. 6d. to 5s.; shipwrights, 2s. 6d. to 3s. 9d.; timekeepers, 2s.; turners, 2s. to 3s. 9d. Men receiving 3s. 9d. per day and upwards are foremen and skilled operatives. The average wages, including boys, are 2s. to 2s. 6d., but few receiving more. The working hours are ten in summer and nine in winter, but a deduction is made for the shorter time worked in winter. Overtime is paid for at the same rate as ordinary time. The poorer operatives at from 2s. to 2s. 6d. per day, with a family to support, live chiefly on bread, cheese, vegetables, meat perhaps on Sundays, dried and salted fish; fruit in summer; wine if cheap. The Italian operative is peaceable, content to work long hours for a low wage, lives poorly, dwells in a flat, destitute of all comforts and conveniences. On Sunday, speaking generally, they turn out clean and neatly dressed. The above remarks respecting operatives in Leghorn apply to the whole of Italy, with the exception that wages are higher in the northern than in the southern provinces. The average cost of living for a native of Sicily is £8 a year, but the warmth of the sun is an element of importance. In cities, day labourers on buildings receive from 1s. 3d. to 1s. 10d. per day of fourteen hours; masons for the same time receive 3s. 6d. The lowest paid of all are the agricultural labourers, who largely emigrate to North and South America—River Plate. Strikes seem to have had no practical result beyond embittering the relations between employer and employed.

In Government arsenals the average hours of work per day throughout the year are ten, and pensions may be earned. The income-tax of 2s. 6d. in the pound spares incomes under £16, and grants abatements on incomes under £32, so that the pick of Italian artisans escape it; but they are heavily affected by indirect taxation in the shape of Customs and octroi duties. All articles of food and drink are charged octroi duty on entrance into walled cities throughout Italy on Government account, and municipalities can put extra rates on such articles and on all others. The Government octroi duties are fixed, while the municipal octroi duties vary in different cities.

Sweden: Reduction of railway rates.—The directors of the Swedish State Railways have authorised various reductions of freights on these lines, as regards especially coals, iron, lime, minerals, steel, tiles, timber, and wood. This reduction is believed to be the forerunner of a general revision of rates.

Tangiers: Swedish Commercial Exhibition.—The exhibition of Swedish articles, which has for some time existed at Tangiers, has led to a remarkable increase of trade between Sweden and Morocco. The experiment is worthy of imitation by other countries.

Austria—Electric lighting in Vienna.—"It would seem," writes the Consul, "that nothing is wanting but the necessary capital to bring about the adoption of electric lighting for public as well as private purposes to a much greater extent than at present. The electric companies now transacting business in Vienna have so little capital at their command that they are compelled to insist upon immediate payment for all investments made on behalf of and services rendered to their customers. I am assured by those familiar with the subject that any electric lighting company, irrespective of its system, could at once enter upon a most lucrative and thriving business in Vienna if its capital were sufficient to enable it to extend the necessary credit to its customers. The most important electric lighting company now transacting business in Vienna is that of Siemens and Halske, a branch of a German firm at Berlin. It manufactures its lamps and machines in Germany, imports them into Austria, paying a considerable duty, and thus increasing the price of what might be produced here on much lower terms. This firm has obtained a concession from the Government for the building of a central station, but it seems undecided whether it will avail itself of the privilege. A similar state of things exists with regard to the firm of B. Eggar and Co. From want of capital, the above and other firms have done but a very limited business in Vienna. In the provinces their business is more extensive, as large industrial establishments have made use of the light. In these establishments the price per hour for arc lights varies from 1·2d. to 3·6d., and for incandescent lamps from ·12d. to ·48d., according as gas, steam, or water is used as a motor. The Imperial Continental Gas Association, which has the contract for lighting the city, has organised itself as an electric lighting company, and has contracted for the lighting by electricity of the Burg Theatre, the two Imperial Royal theatres, and the Opera-house. It is brought against the company that it desires only to be in the field so as to take proper care of its extensive business interests against possible competition. The electric systems adopted here are those of Brush, Déry, Edison, Gramme, Gülcher, Hopkinson, Lippernowsky, Schmelsert, and Siemens. The arc lights used are those of Brush, Gramme, Gülcher, Hefner, and Krizels. The incandescent lamps are those of Fox, Edison, Lane, Siemens, and Swan. No reliable or sufficient water can be obtained for electric lighting purposes, but there is water enough for the use of steam engines easily obtainable anywhere in the city. The fuel most generally used in this city is coal, the best quality of which is sold at from 1s. 10d. to 2s. per cwt.

"The contract with the Imperial Continental Gas Association ensures that body a monopoly until the expiration of the contract on 31st October, 1899, up to which time no other company can lay pipes in the street. The price of gas is:—For all-night public flame—sixteen candles—£3 16s. 5d. per annum; a half night's flame, £1 19s. per annum; for private use, the price is 5s. 5d. per 1000 cubic feet; for public use, 4s. per 1000 cubic feet. The total consumption of gas for private and public has been estimated at from 1,758,300,000 to 2,109,960,000 cubic feet. The usual prices paid for ordinary labour are from 2s. to 2s. 6d. a day, and for skilled labour of the highest order from 4s. to 8s. a day. I am informed that the firm of Kremenezky, Mayer, and Co. of 59, Währingerstrasse, Vienna, and also Mr. F. R. Krizik, of Prague, a prominent electrician, surnamed the Czechian Edison, take great interest in the establishment of an electric lighting company in Vienna, and are ready to tender the use of their establishment as a basis for more extensive operations. If American capitalists or electric lighting firms desire to obtain more detailed information they will doubtless receive a speedy answer to all questions, technical or otherwise, from the Honourable Regierungstrath Wien I. Stadiongasse, 4, Vienna, who is an authority on electric lighting, and will gladly communicate with any American firm that may desire to profit by his experience and thorough knowledge of the subject in question."

France—Agricultural machinery.—The United States Consul at Rouen reports:—"The persevering and systematic efforts of makers of American agricultural implements to effect sales in France have not been so successful in the past year as they deserved, the low price of grain having affected the French farmers and influenced their purchasing capacity. At an exhibition of mowing and reaping machines held in this district there were sixteen machines at work at the same time, twelve being of American manufacture, and the other four more or less imitations of American machines. Nearly all of our best makers were represented, and their machines as a general rule were well looked after. It appeared to me that the English mower and reaper, certainly an excellent machine—as it could not fail to be, having well imitated our best machines—owed its success to the fact that an American competing machine required a yard of wire not procurable in the grounds, and for which part of the driver's whip-lash was substituted. In another case the horse attached to the machine refused to move. The prizes were fairly awarded, and the Americans took their share. The mowers and reapers without the binders seem to be preferred, as the climate is damp and much grass is tied up with the straw, and there is great danger of the rotting of the straw or sprouting of the grain if bound up too soon after reaping."

Industries of Germany.—The United States Consul at Sonneberg transmits the following from the *Berliner Tageblatt*:—"One of the most important chapters in the extracts from the reports of the factory inspectors for the year 1885 is composed of the reports on the condition of industry and the demand for labour. These reports are of greater significance since they confirm in general all that has been said in the reports of the Chambers of Commerce and the foreign consuls as to the critical condition of industry. That these prevailing and unfavourable relations must cause a hurtful reaction on the material and social condition of the labouring classes would be naturally true, the truth of which is proved abundantly in the report of the factory inspectors. One must often read between the lines to get at the truth, for there are in the reports very curious twists which were made for the purpose of setting the above-mentioned relations in a more favourable light than they really deserve. For this reason there are in the reports many contradictions which cannot be concealed. It must be borne in mind that the reports were edited by the Home-office, and naturally enough it would not wish to send into the country evidence against the prevailing theory of political economy. The reports on the condition of industry and the demand for labour stated that in general, as in the previous year, much work was done at reduced wages, though this state of things varied according to the districts, and with slight exceptions in all the districts; the number of establishments and labourers has increased, yet the increase of labourers has been relatively smaller than that of trade, owing to the increased use of machinery in place of labour. The result of this tendency is a constantly increasing crippling of the smaller business in comparison with the larger. This is especially the case in shoemaking and the textile industries, the wholesale manufacturers taking the place of hand production. In some of the districts it is stated that the unfavourable condition of agriculture reacts on industry, particularly machine industry. The foregoing sentences correctly sketch the general conditions of industry, but how do the many opportunities of work which were presented agree with this? If the increase of labour is not equal to that of business, if in the development of industry the tendency prevails to displace hand work by machinery, and if the smaller establishments are thereby kept in the background in comparison with the larger ones, it is perfectly clear that the field in which human hands are demanded must become constantly narrower, and in that endless progression there must be a surplus of hand labourers. The above-mentioned many opportunities for work can hardly be considered representative of the facts. The reports appear to find consolation in the fact that the condition of industry is not everywhere altogether unfavourable, and in many cases has not at all reacted on the condition of the labourers, and that the manufacturers had often kept wages at the same rate in spite of the unfavourable conditions of business. This practice seems in many cases likely to cease. In the report of Merseburg, Erfurt, it is stated that entire classes of labourers have not been affected by a reduction of wages, but both a diminution in the working hours and a reduction of wages of contractors and jobbers in some branches appear to be threatened. A short time ago the same things were expected to take place among the labourers in the Rhine-Westphalian coal industry. It should be noted that in the provinces where industry is most developed these relations are the most unfavourable. In the district of Dusseldorf the report is the suspension of establishments of an important nature have not occurred, but the business was considerably less than in the previous year. In many establishments the number of hands has been diminished, holidays or smaller jobs have been introduced, and in some cases the wages have been lowered, so that the entire pay of the working classes seems to have been lowered. At Aix-la-Chapelle the number of labourers is somewhat lessened, but the diminution of industrial pursuits has been relatively larger than that of the number of labourers. The result of the diminution of industrial pursuits has been that in many cases the number of working hours has been considerably reduced. In the district of Leipsic the number of labourers has increased in spite of the unfavourable condition of industry. In almost all branches there are increased complaints of damaging competition, low prices of manufactures over production, and the consequent unsatisfactory profits of industrial enterprises. These, together with reduction of the prices of raw material, has caused the shortening of the hours of work, lowering of wages, discharge of labourers, and suspension of entire establishments. In Thuringia the textile industry is said to be ruined. In Anhalt, Brunswick, Erfurt, and Merseburg, the sugar industry is in a depressed state, which naturally influences the labourers. The same is the case with the manufacture of machinery and mining; on the other hand, in some branches a brisk business has been carried on, but it is in the less important industries. It may be asserted that the increase of business and establishments in many districts is only apparent. The report from the district of Dresden states the business establishments of the district have partly increased, partly been enlarged; but these extensions must be regarded as the last endeavours to try to reach the profits of former years. There was an almost universal standstill, particularly at the end of the year, if not retrogression of the largest business establishments, which manifested itself chiefly in a diminution of the working hours.

The following observations of the factory inspectors of the district of Zivikau are characteristic of our industrial relations: "Since with every and to any extent favourable condition of business, attempts are made to enlarge existing establishments and to furnish them with machines capable of performing a great amount of work, or to establish new factories by making use of the liberal terms offered by machine manufacturers, the production of goods must be increased above the usual demand." The report from the Black Forest district of Wurtemberg states:—"In all businesses it becomes more and more necessary to manufacture much, so as to make anything." That shows that the danger of a further over-production is still imminent. The representations of the Chambers of Commerce as to the unfavourable condition of industry have been designated as coming from the chief opponents of the prevailing political economy. It cannot be said that the factory inspectors have placed themselves in opposition to the commercial views which maintains the right of restriction, exactly the opposite is to be recognised as true. In spite of that they have confirmed the reports of the Chambers of Commerce, and been compelled to pass an unfavourable sentence on the new political economy.

[1] Coppersmiths at 5s. 10d. a day are skilled men taken on for a special job, and not continuously employed.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—George Hardinge, chief engineer, to the Thalia; William H. Pibworth, engineer, to the Elgin; and Richard H. Trubshaw, fleet engineer, to the Iris, to date March 9.

FOREIGN AGENTS FOR THE SALE OF THE ENGINEER.

PARIS.—Madame BOYVEAU, *Rue de la Banque.*
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CONTENTS.

TO CORRESPONDENTS.

Registered Telegraphic Address "ENGINEER NEWSPAPER, LONDON."

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

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

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

W. B. N.—*"A Treatise on Belts and Pulleys," by J. Howard Cromwell, Ph.B. London: Trübner and Co.*

INDICATOR.—*Get a Richards' indicator, old pattern. The makers—Messrs. Elliott, Strand—will send the proper springs if you state the pressures.*

W. G.—*You can see the printed specification of any published patent in the Library of the Great Seal Patent-office, Southampton-buildings, Chancery-lane, without charge of any kind.*

A. G.—*The total expansion is found by dividing the space filled in the first cylinder with fresh steam from the boiler, into the space filled in the low-pressure cylinder at the moment the exhaust port opens.*

D. B. H.—*The section you show is badly designed for cast iron. It would have a breaking strength of but* 15 *tons in the centre, or* 30 *tons if distributed. A rolled girder of similar depth, and weighing, say,* 70 *lb. per yard, would carry safely a distributed load of about* 26 *tons, or say* 13 *tons at centre.*

A SLEEPER.—*The precise form proposed by you has not, we believe, been made, but partial punching-out and bending-up to form chair or clip is recently quite common. The objection to the system is that the clip or chair so made often breaks. The iron or steel that is good enough, or has been worked enough, for the sleeper does not appear to be so for the clip or chair. A broken clip means a useless sleeper, and to prevent breakage the clips have to be made short and strong. You might get yours taken up, but it is very questionable.*

DRUG MILLS.

(To the Editor of The Engineer.)

SIR,—Will any reader give me the address of a maker of hooded mills for grinding poisonous substances? COLONIAL.
March 17th.

QUARTZ-CRUSHING MACHINES.

(To the Editor of The Engineer.)

SIR,—Would any of your readers kindly give me the maker's name and address of the "Sutherland Gold Quartz Crusher?" and oblige V. E. F.

COIR FIBRE MACHINERY.

(To the Editor of The Engineer.)

SIR,—We should feel obliged if you would kindly give us the name of a good maker of machinery for combing or dressing coir yarn.
Liverpool, March 15th. H. S. V.

COMPOUND ENGINES.

(To the Editor of The Engineer.)

SIR,—I believe there is a very simple method of calculating the pressure between the cylinders of compound engines in use in some of the shops in the North. It is not quite accurate, but is a good approximation. I shall be very much obliged to any of your North-country readers who will tell me what the rule is. A SOUTHERN ENGINEER.
Southampton, March 15th.

6-H.P. ENGINES AND PUMPS FOR THE INDIAN STATE RAILWAYS.

(To the Editor of The Engineer.)

SIR,—We note that you say that the 6-H.P. engines, boilers, and pumps for the Indian State Railways—illustrated in your issue of March 4th—were made by Messrs. Hayward Tyler and Co. This may be quite correct; and we are finishing six sets of the same for the Indian State Railways. The tracing sent you on the 9th shows the arrangement of well gearing in our case. GLENFIELD COMPANY, KILMARNOCK.

ROWING CLUBS.

(To the Editor of The Engineer.)

SIR,—The attention of the Department has again been called to the fact that contractors are frequently solicited for subscriptions on behalf of rowing clubs, &c., purporting to be in connection with the Royal Arsenal at Woolwich. The public press has been asked to notice this before, but as the annoyance still continues, the Secretary of State wishes to say in your columns that nothing of the sort is authorised by the War-office, and that the Department views with strong disapproval any attempt to collect subscriptions from contractors.

EVAN COLVILLE NEPEAN,
Director of Army Contracts.

War-office, Pall Mall, S.W., March 15th.

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Advertisements cannot be inserted unless Delivered before Six o'clock on Thursday Evening in each week.

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Session 1886-87. Tuesday, March 22nd, at 8 p.m.: Ordinary meeting. Paper to be further discussed:—"The Treatment of Gun-steel," by Colonel E. Maitland, R.A., Assoc. Inst. C.E. Thursday, March 24th, at 8 p.m.: "On the Resistance of Faults in Submarine Cables," by A. E. Kennelly.

SOCIETY OF ARTS, John-street, Adelphi, London, W.C. — Monday, March 21st, at 8 p.m.: Cantor Lectures. "Machines for Testing Materials, especially Iron and Steel," by Professor W. C. Unwin, F.R.S. Lecture I.—Objects of testing materials—Scientific and commercial objects—Strictly relative character of ordinary testing—Elasticity and plasticity—Tension and compression—Behaviour of brittle and ductile materials—Stress-strain diagrams—Classification of testing machines—Arrangement of testing machines—Weighing apparatus—Straining apparatus—Knife edges—Description of some typical machines—Greenwood and Batley machine—Wicksteed machine—Grafenstaden machine—Werder machine. Wednesday, March 23rd, at 8 p.m.: Ordinary meeting. "Some of the Conditions Affecting the Distribution of Micro-organisms in the Atmosphere," by Dr. Percy Frankland; Professor Burdon Sanderson, M.A., M.D., LL.D., F.R.S., will preside. Friday, March 25th, at 8 p.m.: Indian Section. "Indian Coffee," by Frederick Clifford.

SOCIETY OF ARCHITECTS.—Tuesday, March 22nd, in the Freemasons' Tavern, Great Queen-street, W.C., at 7 o'clock p.m.: Ordinary meeting. Paper to be read:—"Housing the Poor," by W. Allport.

THE ENGINEER.

MARCH 18, 1887.

ADMIRALTY CONTRACTS.

THE Lords of the Admiralty deemed it necessary to appoint a Committee to inquire into the working of the existing system, or want of system, followed in placing contracts for naval stores, ships, engines, coal, and supplies of all kinds. The report of this Committee has just been made public. We do not propose to reproduce the report or the recommendations and suggestions which it contains. Those within the official veil need not be told what they are; to those outside they would be to a very large extent entirely unintelligible. We shall act to better purpose if we confine ourselves to considering certain special points. The methods heretofore adopted by the Admiralty have been in very many respects as bad as they can be. The result has been waste of money, stores, and time. But we fail to see that, even if all the recommendations of the report were carried out, they would do more than alleviate matters. They could not cure a disease which appears to be quite inseparable from the existing system of Government by Party. Putting on one side the strictly naval affairs of the Admiralty, and directing our attention solely to what we may term its constructive capacity, it is easy to see that the Board differs in no way in its functions from any ordinary board of directors carrying on manufacturing or trading operations. It is clear that such a Board should be composed of men acquainted with the nature of the work to be done, and possessing business capacity and great experience. If the Board have to manage several establishments in various parts of the country, care would be taken to prevent these establishments from clashing; and as far as is consistent with the ruling conditions—the environment, so to speak, of each establishment—the system of work adopted in one would be adopted throughout. It is not too much to say that the method under which Admiralty work of all kinds is carried on has nothing in common with that which we have indicated. The construction of the Board of Admiralty changes with the accession to power of each political party; and with few exceptions the Lords of the Admiralty have no experience whatever as specialists in the work they are called upon to perform. The result is, of course, that they are helpless in the hands of officials. These gentlemen can get work done somehow. Without their experience and special knowledge the Board of Admiralty could not get the work done at all. Every man who has a seat on the Board knows that there are abuses of all kinds to be remedied. Of the precise nature and operation of these abuses he has no idea whatever. He feels that it is incumbent on him to do something, and in nine cases out of ten, with the best intentions in the world, he does more harm than good. The proverbial tinker in mending one hole in a kettle makes two others; so it has always been with the Admiralty. Nothing short of an entire change will operate for good, and of this there is not just now the smallest chance. The present First Lord of the Admiralty may do what in him lies. It would require years to carry out the sweeping reforms necessary. He may be out of office at any moment, and his successor may hold entirely different views. The changes introduced by one man may be re-changed by the next. There is no possibility of continuity of reform under such conditions, nor can there be while reform depends on whether the Government of the day has or has not a majority in the House of Commons. The result of all this is, of course, that while the nominal management is in the hands of the Lords of the Admiralty, the real managers are the officials. To use an expressive Yankee phrase, it is they who "run" the Navy. It is but human nature that the head of each department should think more of it than of other departments; and when we bear in mind how many departments there are, and how far apart our dockyards are placed, it is not wonderful that confusion, waste, and delay are rampant. Much is laid to the charge of red tape, but red tape is really essential to prevent naval affairs falling into utter chaos. We must not blame a wooden leg for the slow progress of a cripple. Without the wooden leg he could not make any progress whatever. There is nothing radically wrong in placing a great deal of power in the hands of officials. If the best men are selected and properly paid, they will, if they are endowed with sufficient power, constitute the best agency that can be employed to suppress existing evils and remedy existing defects. But such men have no chance at the Admiralty. There is always the possibility—nay, the strongest probability—that their advice will be disregarded by my lords. Is it remarkable that under such conditions they should refuse to advise, and content themselves with doing their official work and drawing their official pay? They accept the system as they find it, knowing that any changes they might make would represent so much waste effort.

If we examine the recommendations of the Committee we shall find nothing which appears in any way to meet the difficulties we have indicated as standing in the way of Admiralty reform. No doubt they are good in their way, but is it likely that they can be carried out? or that, if they are carried out, they will be found in practice to work as well as in theory they seem likely to do? They result from no special knowledge possessed by the members of the Committee. These gentlemen examined a large number of witnesses, and their report is simply a species of verdict based on the evidence placed before them. It is easy to see that this evidence is, to a large extent, incomplete, and the verdict is proportionately reduced in value. Popular interest has centred round one portion of the inquiry, and it will be instructive to consider that at some length, because the circumstances illustrate what we have just said concerning the incompleteness of the evidence and the value of the verdict based on it. The point in question is the price to be paid for the engines of two new men-of-war, the Renown and the Sanspareil. Tenders were asked in April, 1885, for the construction of these two ships and their engines. The conditions were that the engines must not indicate less than 8500-horse power, but that more might be given. Whatever the power contracted for the engines must exert it, or a penalty of £12 for each horse-power deficient would have to be paid. Fifteen tenders were put in, ranging from £587,854 to £610,800. In the end the contract for the Renown was given to Messrs. Sir W. Armstrong and Co., the engines to be made by Messrs. Humphry, Tennant and Co.; the total cost of ship and engines being £604,000, that of the machinery being £99,000, the engines to indicate 10,000-horse power. The contract for the Sanspareil went to the Thames Company. The engines to indicate 10,000-horse power, and to be made by Messrs. Humphry, Tennant and Co.; the total cost to be £601,000; the engines to cost £97,000. The Admiralty Committee consisted of Mr Arthur B. Forwood, chairman; Mr. J. P. Corry, Mr. B. Hingley, Mr. W. Pearce, and Mr. G. FitzGerald. Mr. Pearce is the representative of the firm of John Elder and Co., and he very sharply cross-examined Sir N. Barnaby and Mr. Wright concerning the circumstances under which tenders were asked for and orders given for the engines in question. It will be seen that the higher tenders were accepted, and the Committee report on the matter as follows:—"In advising the Board to accept these higher tenders, the late professional officers, Sir N. Barnaby, K.C.B., and Mr. Wright, C.B., with the concurrence of the present acting engineer-in-chief, Mr. Sennett, submitted that the 1500 additional horse-power represented £15,000 in each vessel, or £10 per indicated horse-power. In estimating the relative prices of the several tenders they stated that they had deducted this amount from the tenders recommended for acceptance, thus placing one £1800 below the lowest offer—viz., that of Messrs. Palmer, and the other about £1200 in excess. This valuation of the additional power was perfectly arbitrary, a mere matter of opinion, and quite at variance, according to the evidence given to the Committee, with the intrinsic cost of its attainment, viewed by the addition it required to the engines and boilers. One witness of large experience estimated the extra cost at only £2000. In confirmation of this view, it may be stated that subsequent to the opening of the tenders, but prior to a decision thereon when it became known, much importance was attached to an increased power. Messrs. Elder and Co. offered to provide this addition without extra charge. Messrs. Palmer and Co. also proposed to increase the guaranteed power to 9000 I.H.P. free of cost. Both the accepted tenders stated on their face that the extra charge of the engine-makers for the additional 1500 indicated horse-power was £8000. Accompanying some of the other tenders were communications from engineers indicating their opinion that the engines as specified would develope a larger power than that called for in the specification. It is extraordinary that these important particulars were not brought under the notice of the Board; had they been, the fallacious character of the valuation of £15,000 in respect of each ship for this extra power as given by the officers would have been patent."

This statement appears to us to be very unfair to Sir N. Barnaby and Mr. Wright. Something seems to have

been kept back. In the first place, Sir N. Barnaby and Mr. Wright were not mistaken in considering that the extra power which could give the ship an extra speed was worth £10 per horse-power, and nothing is said in the passage which we have quoted concerning the fact that the contractors for the engines ran the risk of losing the whole or part of the £15,000. For example, if the engines only indicated 8500-horse power the contractors would be penalised to the extent of £18,000. The evidence given by one witness to the effect that the difference between 8500-horse power and 10,000 would not exceed £2000 seems to be of very doubtful value, because he did not fully understand the conditions. The statement that Messrs. Elder volunteered to give the additional power without extra charge must be taken with large qualifications. In the first place, the price to be paid to the firm on their first tender for the engines was £105,000 for 8500-horse power, or £8000 more than Humphrys, Tennant, and Co. charged for 10,000-horse power. In the second place, Mr. Pearce put his firm out of Court. The original tenders were opened on the 16th of April, 1885. Mr. Pearce put in three tenders subsequently; No. 1 on the 17th of April, No. 2 on the 17th of April, and No. 3 on the 18th of April. It is obvious that the Admiralty could not consider tenders made by one firm after the tenders made by other firms had been opened. It must remain an inscrutable mystery why Mr. Pearce's alternative tenders were not sent in until the other tenders had been opened, and what were the causes that induced him to modify his original offer with such promptitude. Now Mr. Pearce, be it remembered, was one of the Committee, and his examination of Sir N. Barnaby and Mr. Wright was so adverse that it evoked the unfavourable comments of the *Times*. Mr. Pearce feeling himself injured, has written a long letter to that journal defending himself, and incidentally mentioning that he had tendered no less than forty-seven times, and never had got an Admiralty order. To assume that Mr. Pearce could, under the circumstances, and try as he might, be an impartial judge of the conduct of Admiralty officials in the letting of contracts would also be to assume that he is more than human. We intend no disparagement when we say that Mr. Pearce should never have been placed in the trying position in which he found himself when he became a member of the Committee. The report is, however, not more unfair to Sir N. Barnaby and Mr. Wright than it is to Messrs. Humphrys, Tennant, and Co. It will be seen that these gentlemen are charged with something akin to very sharp practice indeed. "The tenders accepted were one at £94,000, and one at £95,350, the former being from the same firm—Humphrys, Tennant, and Co.—who in August obtained by negotiation £112,000 for that which in February following, after competition, they offered at £94,000." The £112,000 refers to the machinery of the Trafalgar. It is difficult to understand how Mr. Pearce permitted this statement to be made, because he, at all events, must have understood the facts and the bearing of the facts, although the other members of the Committee did not. Messrs. Humphrys, Tennant, and Co. have very properly pointed out since that (1) the engines are *fac simile*, and therefore much cheaper to repeat; (2) the boiler arrangement is entirely different. In the Renown and Sanspareil the heating surface is distributed in eight boilers and four stokeholes; in the Trafalgar it is distributed in six boilers and two stokeholes. Not only does this make a substantial reduction in the cost of the boilers themselves, but it very much reduces the cost of the boiler mountings—forced draught fans and engines, feed engines, copper piping, and stokehole outfits. This very important factor in estimating the relative cost of the two contracts is entirely omitted in the report, although the engineering officials refer to it in their evidence. There is a considerable saving—indeed, a very large saving—on the cost of the crank shafts and propeller shafting of the Trafalgar, and there are other matters of less importance, all tending still further to reduce the cost. The only fault committed by Sir N. Barnaby and Mr. Wright seems to have been part of the existing system, and consisted in asking firms to tender who were deemed unlikely to fulfil the conditions. Messrs. Harland and Woolf were among those who tendered. Mr. Wright being asked to explain why they were asked if they were deemed unable to compete, gave an answer which illustrates what we have said concerning the influence of political party feeling in Whitehall—"They were asked to tender because there had been a talk about justice to Ireland." This kind of thing would be ludicrous if it were not deplorable.

Toward the end of Mr. Pearce's letter before alluded to will be found a remarkable statement, which we cannot pass by without comment:—"Is it not preposterous that Great Britain, with her magnificent mercantile marine, has not a single ship of war that can cross the Atlantic at full speed? In fact, I cannot recall a single British armourclad that could reach New York at all under her own steam power. And this state of things exists while the journals of to-day record that the Cunard liner Etruria crossed the Atlantic at an average speed throughout of $19\frac{4}{10}$ of a knot per hour! Why cannot the nation boast of a similar performance on the part of her Navy? The fault lies in the existing system of divided responsibility, and it is to this point that the Committee has chiefly directed its inquiries. A careful perusal of the evidence will show that in every case of purchase and contract the responsibility is shifted from one to another—a part rests here, a part there, and even the temporary clerks or copyists appear to have sometimes an important share of the responsibility, especially when something has gone wrong." We need scarcely point out that the Etruria could not carry armour and maintain her present speed, to say nothing of heavy guns; that, in fact, there is nothing in common between an Atlantic liner and an ironclad. This is not the question we wish to raise, however, but this: The engines of the Etruria are rather more powerful than those of the Renown and Sanspareil. It would be very instructive if Mr. Pearce would tell us what price was paid for them by the Cunard Company. There is reason to believe that the Admiralty always pays a great deal more for machinery than would be paid by private firms. The reason why we shall perhaps consider another time.

UNITED STATES RAILWAY CATASTROPHES.

It goes without saying that a very large number of so-called railway accidents occur every year in the United States. This is what is to be expected in a country with an enormous gross length of railway, much of which has been made as cheaply as possible. It is only in comparatively limited districts close to great towns that elaborate and costly systems of signalling, &c., are to be found. Under the circumstances, what may be called small accidents—minor catastrophes causing the loss of few if any lives—may be regarded as, to a certain extent, excusable, on the ground that they are unavoidable; but, unfortunately, railway catastrophes at the other side of the Atlantic are not always trifling. Within a comparatively short period four of a peculiarly dreadful nature have taken place. In one, known as the Republic disaster, a collision was followed by the roasting alive of many passengers, under circumstances of unmitigated horror. In the second, some twenty persons met their deaths by being swept off an unprotected platform at the side of the elevated railway into the street, some 30ft. below; and on Monday a bridge gave way near Jamaica Plain, on the Dedham branch of the Boston and Providence Railroad. The accounts which have reached this country by telegraph are, of course, not yet complete. Enough is known, however. At seven o'clock a local train, composed of seven cars, all filled with working people, left Dedham for Boston. As the train was passing over a bridge about a mile from Jamaica Plain, a suburb of Boston, the bridge gave way, whether from structural weakness or from exceptional accident, is not certain. It is said that the bogie of one of the cars broke, and that the car struck an abutment with such force as to break it away. In any case, a gap was made in the roadway, and four of the cars were precipitated through it, falling a distance of 50ft. The first car which fell, a smoking carriage, was overturned, and the three others dashed down upon it, breaking through it, and smashing it to splinters. All the occupants of this car were either killed or terribly injured, and few of the people in the other carriages escaped without severe injury. While the work of rescuing the unfortunate passengers from the *débris* was proceeding, reminiscences of the late White River disaster suggested the fear that the wrecked carriages might take fire. Accordingly a fire-engine from Roslindale, a place in the neighbourhood, was brought with all speed, and this played upon the *débris* so effectually as to prevent any outbreak of fire. The list of killed and injured is a long one. Thirty-two persons were killed, including both men and women, and about forty injured. Among the latter are several of whose recovery there is no hope at all. Of the dead, twenty-seven have been identified and five are unknown. Most of the bodies were fearfully mangled, some being decapitated.

The three events which we have named cannot properly be called accidents in any sense of the word. Nothing of a similar kind occurs when proper precautions are taken to carry passengers in safety. Only two inquiries have yet been held. One deals with the White River disaster, to which we shall refer presently. The second deals with the Republic catastrophe. The coroner's verdict is long and outspoken—too long to reproduce here. It will be remembered that a goods train stopped, the engine breaking down, and that it was run into by the express following close on its heels. The verdict of the coroner states that "The freight engine was in an unsafe and unserviceable condition, and the officials of the road had been notified of this fact, but still allowed it to be used. The engineer of the freight, Edward S. Kiler, was not intoxicated, but was worn out with sixteen hours and fifty minutes' continual duty with a green fireman and a poor engine. He had plenty of time to get to Republic from Seneca siding, but his engine was so poor and unserviceable that it died on the track at the point of collision." This is terse and idiomatic language, quite to the point. The verdict then goes on to say that the goods guard in charge of the train did not go back, as he ought to have done, to warn the express, although he knew it was due in ten minutes. The coroner could not pass over the burning of the wrecked train, and he says: "I further find that the heating apparatus used on passenger cars of this division of the Baltimore and Ohio Railroad is dangerous in the extreme to the lives of passengers thereon in case of accident, wherein cars are crushed or overturned, and that they are contrary to and in violation of Section 335 of the revised statues of Ohio. The lighting of the cars is dangerous, and on account of the unlawful and unsafe manner in which the cars of limited express train No. 5 were heated and lighted, the loss of life was increased. And I do further find that William Frederick and others came to their deaths through gross negligence on the part of the officials and managers of this division of the Baltimore and Ohio Railroad Company, of Garrett, Ind., in sending out engine No. 923 upon the railroad the morning of January 3rd, 1887, when they well knew that engine was in an unfit, unserviceable, and dangerous condition, and through gross negligence on the part of conductor L. F. Fletcher as conductor of freight train No. 26 in failing and neglecting to properly flag and signal the limited express train, and in failing and neglecting to fully protect his train and the limited express, and through gross negligence on the part of the owners, officials, and managers of the Baltimore and Ohio Railroad Company in having upon the limited express train at the time of the collision inferior, ineffective, and unsafe brakes." The Loughridge brake, as used on the Baltimore and Ohio, is simply a straight-air brake, similar in principle, though different in detail, to the original non-automatic Westinghouse air brake. This, as has been well remarked by an American contemporary, is a "terrible indictment;" probably the heaviest ever urged against a railway company. We have never had anything at all like it brought against an English company. What may be the verdict in the case last reported we are unable to say, but if it turns out that the bridge which gave way was, as is said, a new one structurally, the responsibility of those who passed it as sound and sufficient will be indeed tremendous.

On February 5th a fearful event took place at White River, on the Central Vermont Railway. Not far from a place called Hartford is a bridge over the White River. At a point 510ft. from the abutment at the south end of the bridge, while the train was moving at a speed of less than twelve miles an hour, the rear sleeping car was thrown from the rails, but kept the road-bed until it came upon the bridge, when the rear end swung to the right side of the track to the deck of the bridge, and thence to the frozen river below, a distance of 43ft., drawing with it the sleeper and the two coaches in front, all of which were crushed in the wreck upon the ice. The coupling between the Boston coach and the combination mail and smoking car, broke or unclasped, so that the rest of the train was saved. Some of the cars immediately took fire, and within fifteen minutes of the time they fell to the ice they were all enveloped in flames, which reached and set fire to the bridge, which soon fell alongside the burning cars, the wind blowing the flames of the burning timbers directly upon them. The intensely cold weather—18 deg. below zero—added to the peril of those who survived. Twenty-four passengers lost their lives, and five train men; besides thirty-six passengers who are known to have been injured. The cause of the calamity was the breaking of a 60 lb. steel rail with a flaw in it. It has often been denied that American mills produce inferior rails, but there seems to be very little doubt that the statement is quite true. But, granting that a broken rail threw the sleeping car off the track, it by no means follows that the train, running at but twelve miles an hour, should plunge on to the ice-bound river below. In a distance of 510ft. there was ample time to have pulled up the train, had the brakes been of the right kind and properly used. Even though the train had not been stopped, still, if the bridge had been properly made, no evil consequences would have ensued. The committee appointed to inquire into the circumstances acquit the company, but they add a very significant rider:—"It seems proper speaking upon this matter, to advise all the railroad companies to take into consideration the most approved methods in vogue anywhere for the better equipment of their bridge approaches where needed, with strong buttresses, flaring safety beams, or other practical devices to diminish the fatality of this class of accidents. Such reasonable precautions should be taken before rather than after the occurrence of any fatal calamity."

It is more important to ascertain whether any steps can or will be taken to prevent such catastrophes in future, than it is to consider precisely in what way those that are past have been brought about. The *Railway Review*, published at Chicago on February 26th, says:—"The times call for decided reform in these and similar matters, and the fact that there are other roads that are liable to contribute any day another Republic horror with the same conditions that the Baltimore and Ohio management afforded—except in the matter of the brakes—strengthens rather than weakens the spirit of the verdict above quoted." Since these words were written the Boston catastrophe has taken place. It is more than probable that it is by no means the last contribution to the dark history of American railways. We may rest assured that nothing will be done just yet. Some compensation may or may not be paid but the railways are, after all, the masters of the situation. There are indications, it is true, that the people of the United States are indisposed to submit much longer to the tyranny under which they groan. The Railway Bill already dealt with in our columns may be regarded as a step in the right direction, but something much more than this is wanted. If the railway companies and their officials will not of themselves take proper precautions to secure human life, then the Legislature must interfere to compel them to do their duty. A thoughtful paper appeared last July in *Harper's Magazine*, which brings heavy charges against the railway system of the United States. These charges go far to explain such deplorable events as those on which we are commenting. The writer, Mr. R. T. Ely, says: "The first consideration, then, to be borne in mind in any attempt to understand the nature of the railway problem is this—the railways must become still more completely our masters or they must be reduced to complete subjection to us as their masters. There is no middle ground. We are dealing with the problem of economic liberty." In another place he says: "Look to California and you will find a Legislature which is said to be the tool of the Central Pacific, and we discover a Railway Commission unable to enforce the laws of the land. In Ohio you learn that the Standard Oil Company, a creature of the railways, controls the Legislature in opposition to the interests of the people. Nor do even our municipality escape this malign influence."

Something will probably be heard concerning mechanical imperfections. Scientific evidence will be called in; blame will be attached to unfortunate subordinates, and so the evil hour will be tided over; but the truth will remain, whether it prevails or not. The catastrophes which disgrace American railways are simply the result of bad, irresponsible management. They are entirely unnecessary. They are perfectly avoidable. They would not occur if the railway companies would do their duty by the public. It may be said that all this is no affair of ours. In a sense this is true; in another sense it is very much our affair. The world will not be slow to say that such things are a disgrace to engineers. This is not true. Engineers, in the proper, honest sense of the term, do not design, make, or permit to be put up, bridges which break down. They will not run trains which are devoid of everything which can secure safety, while they are replete

with those which mean death. Such things are a disgrace to the men who pass themselves off as engineers, and pose before the world as the best, the wisest, and the most clever of mankind; either knowing the while nothing of their profession, or mean and dishonest enough to prostitute their talents and abandon their convictions for the sake of a little gold. Such things are a disgrace to railway directors, to whom human life is of no value; and lastly, they are a disgrace to a great nation which permits its children to be slaughtered wholesale, because it is too indolent or too corrupt to compel the railway companies to do their duty.

METHODS OF PAYING WORKERS IN MACHINE SHOPS.

Although there is a good deal of literature extant on the subject of labour and wages, it is so scattered that the person who addresses himself to the task of studying the matter finds that he must consult many essays and pamphlets, and then, by a process of mental digestion, endeavour to form his own opinion. In these high-speed times it is important that every source of information on any useful or important subject should be as accessible as possible, and that the literature of it should be as explicit and as concise as it can be made. The wages question, at all times an important one, becomes more so every day, especially in an old country like England; and if any man possessed of the requisite ability would address himself to the task of preparing a treatise codifying the various systems by which wages may be paid, even in one branch of engineering industry, such a book, if well done, would, we venture to think, help to make the relative commercial position of employers and employed more clear to each other, and perhaps tend in some degree to reduce the number of labour disputes, those progenitors of strikes and lock-outs which, if the workmen of Great Britain could once be brought to see it, are slowly killing the trade of the country and strengthening foreign competition against it. We cannot, within the narrow limits of an article like this, attempt to do more than sketch the outline of the principles on which wages are or may be paid, and state in general terms the arguments for and against each system. Taking, then, a machine works employing, say, a thousand hands, and with a certain capital invested. The owner of these works may pay his operatives in several ways. One is by time, the hour being the standard; for although wages are paid weekly, a week's work means, and must mean, so many working hours. Under this system the result to the master depends upon the industry of his men. If they are idle, they are idle at his expense. This, it will be obvious to the meanest intelligence, is opposed to every principle not alone of justice, but of every propriety or fitness of commercial business. The time worker sells his time to his employer, and it is no longer his. The master must rely to a great extent on the honesty of his men. The old adage tells us that the eye of the master does more than the hand of the servant. Just so; but the age of miracles is past, and a master cannot have his eyes everywhere at once. The only safeguard he has lies in his practical experience of what constitutes a fair day's work, and in dismissing the man who, after due warning, fails to render it. The real remedy against idleness is to convince the workman that his master's interest and his own are identical. Every act of malpractice that in any way tends to impoverish his employer must in the end damage the man himself also. A bankrupt employer must be ever a bad paymaster.

Another system, and one that masters have been compelled to adopt to a large extent, is that of piecework. By it the workman has the control of results largely in his own hands for a time. We say for a time, because there is room here also for a dishonest worker to do his employer a great deal of injury before his character is found out. The most vigilant foreman or works' manager cannot always detect scamping; and besides this, even where it is discovered, the time question comes in, and a waster or two found in the execution of a job done under a penalised, or even under a bonused order, causes loss to the firm, tends to injure its reputation, and ultimately to injure the workmen themselves, by driving work elsewhere by failure to be up to time.

A third system of payment is that of co-operation. Superficially regarded, this system has a very inviting aspect. It seems to contain the one thing wanting. It tends to make the identity of his own interests with those of his employer plain and convincing to the workman. In fact, he is no longer a workman; he becomes a partner, and one also on very favourable terms, for while, on the one hand, he shares the profits, he has no anxiety about capital invested, he is free from the many cares and business worries which literally in many cases harass the life out of his employer. Two defects are, however, present with this system—one is somewhat the same as that present with the collection of the income-tax. It involves a certain infraction of privacy. No one quite relishes making known to outsiders the amount of his income, but the co-operative system of wage paying involves; of course, an audit of the books on behalf of the men. The second defect is due to the modern nomadic disposition of workmen themselves. In former days workmen had an *esprit de corps*, an attachment to and pride in their respective shops; a healthy rivalry existed between shop and shop that has altogether vanished now. The system of co-operation involves, as a necessary condition of its successful application, permanence of relations between workmen and particular shops. The Clearing-house is one of the marvels of modern business, but we doubt if even it could deduce or accurately determine the bonuses due to a workman who runs a lathe in Newcastle for two months, a planing machine in Manchester for three months, and spends the rest of the year between a machine shop in Liverpool and another in Leeds.

A fourth system—one adopted in certain American shops, especially those worked by companies—is that which we may call the share system. Under it any man or boy who is sufficiently thrifty can purchase a share in the concern. We believe that a share may in some shops be bought for so small a sum as a dollar, and the investor is paid his dividend as faithfully as is the largest shareholder in the concern. This has the advantage already shown to attend the co-operative system, and has the additional one besides of tending to some extent to check the movement of workmen. The man's heart is with his treasure. Incidentally with this system goes, we understand, promotion by purchase. Other things being equal, the man holding most shares will be made a leading hand, a foreman, or so forth, over the head possibly of an older man who is a smaller investor. This system ought in some respects to work well, although in others it is highly objectionable. To estimate the value of a foreman by the number of shares he holds seems to be radically bad. The possible argument against the system that labour disputes are numerous and acrimonious in the States, which some persons may advance against it, cannot be received until it is shown that disputes arise in cases where it is in operation.

Thus we have, as we said, endeavoured faintly to sketch out certain systems of paying wages, and have confined our remarks to a single branch of industry. We have not adverted to the system of paying wages in kind, commonly known as the truck system. It is a relic of a rude and semi-barbarous state of society, when hardly any standard form of currency was generally available, and therefore the primitive system of payment in kind was of necessity adopted. Yet even now in certain districts, and subject to proper supervision and restrictions, the truck system may very well be an advantageous one to workmen; and legislation has done much to clear it of abuses. The tables we are now publishing of British wages and cost of living will, we trust, prove valuable both to employers and employed; but we cannot end this article without expressing a hope that some competent person or persons will undertake the task of preparing a good concise treatise on the various methods of wage paying and their operation, both as affecting British trade in general and also the relations between capital and labour between employers and employed. It is a subject that might well occupy the attention even of a Royal Commission. Meantime we would—as gentleness of speech and pen is the rule now-a-days, even when circumstances indicate that forcible language is alone appropriate—invite trades' union agitators to take into consideration whether it would not be sound wisdom to realise that fact which is patent to all who regard these things with an unbiassed mind—that the main interests of the working man are and must always remain identical with those of capital owners.

OPEN-HEARTH STEEL IN THE NORTH-EAST.

The north-east of England was slow to take up the open-hearth steel manufacture on a scale of any magnitude. This was because the use of iron in shipbuilding lingered in that district, owing to the class of vessels mainly built there. In 1884 there were produced in that district 22,000 tons of iron plates monthly, whilst the total output of open-hearth ingots did not exceed 1400 tons monthly. But the rapid increase in the use of steel for shipbuilding forced on the manufacturers of the north-east the production of that material most in demand, and in response the output of steel-plates has gone up rapidly. As we have said, the production of open-hearth ingots in the north-east was on a limited scale in 1884—it was, exactly speaking, 16,400 tons for the year as a whole. But in the first-half of 1885 it shot up to 4470 tons per month; for the second half of the year it was 8100 tons—the total for 1885 being 75,504 tons. And in the last year that increase has been continued. For 1886 the production in the north-east district was 124,100 tons, and now that district stands third in the rank of the producer of ingots by the process named. Other furnaces are building, and with the completion of these and with that increase in the demand, it may fully be expected that in the current year there will be a further increase in the production. Of course that increase is in large degree at the cost of the manufactured iron trade; but it is needful if the north-east coast is to build vessels of the type and kind needed, that it should produce sufficient steel to meet its own requirements. It is noticeable that the open-hearth furnaces were built first at some little distance from the ports where the bulk of their output may be expected to be used—at inland centres, such as the Consett Works, the Weardale Works, and others; but they have now been erected on the Tyne, the Tees, and their extension to other ports is merely a work of time. A few years have brought down the price of steel plates from £20 per ton to between £6 and £7. It is evident that as the output increases there will be, on the whole, a further downward tendency in price, and thus the use of the material will be facilitated either wholly in substitution for iron, or with the use of a little of the older form of the metal. But the growth of the production of the open-hearth steel in the north-eastern district is one of the most remarkable of the proofs of its metallurgical success, and that in the face of the tendency to use the iron which could be produced with little admixture to the pig from the local ores. The growth in some districts was under other conditions; in the north-east it is simply the reply, slowly at first, to a changed form of demand.

THE RATING OF MACHINERY.

In these days when our home industries are gradually being destroyed by the competition of freely-imported foreign manufactures, it is not unreasonable to expect that some effort should be made by ourselves to render the process of extinction as gradual as possible. The Papermakers' Association are petitioning the House of Commons that in any Bill which may be introduced to amend the law of rating, not only may all uncertainty be removed as to the nature of the hereditaments liable to be rated, but that all machinery of the nature of personal chattels, the mere furniture in fact of a mill or manufactory, shall be expressly exempted from local and imperial taxation. There is no doubt that the cost of production in this country is much enhanced by the burden of rates and taxes upon mills and manufactories, which is becoming every day more serious, and from the pressure of which our foreign competitors are to a large extent exempt.

Alterations are at present being made in the fortifications at Tynemouth, which will render the defences of the Tyne the most powerful on the north-east coast.

THE AMERICAN EXHIBITION, LIMITED.

We have been asked of late for information as to the scheme under which the American Exhibition is being promoted in London. We have ascertained that it is being organised by a joint stock company, and an inspection of the file of documents relating to it registered at Somerset House affords the following information:—On the 1st January, 1885, an agreement was entered into between John Robinson Whitley of the first part, General Charles Benjamin Norton, of Boston, Mass., of the second part, and the American Exhibition, Limited, of the third part; the short effect of which is as follows:—Messrs. Whitley and Norton agree to assign to the association "the goodwill of the scheme relating to the Exhibition," and the benefit of all negotiations which are recited to have been made by them for the purpose of the Exhibition, and in return for this Messrs. Whitley and Norton (and a Mr. Applin) are to receive, *inter alia*, the moneys and salaries, and to hold the appointments to which we shall presently refer. About the same time, namely, on the 1st January, 1885, the company was incorporated by the name of The American Exhibition, Limited, under a memorandum of association, signed by the following persons, who subscribed for one share each, viz.:—John Robinson Whitley, 7, Poultry, Director-General of the American Exhibition; Charles Benj. Norton, 7, Poultry, E.C., Secretary of American Exhibition; Ronald Gower, Stafford House; Edward A. Farrington, care of J. S. Morgan and Co., gentleman, of no occupation; John Priestman, European Manager, of Bradstreet's Agency, 84, Newgate-street; Edward Bates Dorsey, C.E., First Avenue Hotel, London; Vincent A. Applin, Solicitor, 7, Poultry.

The memorandum declares the capital of the company to be £100,000, divided into 1000 shares of £100 each, with power to issue any part of the capital for the time being unissued, or any additional capital, with preferential rights or privileges, including preferential claims in the event of winding up of the company. The articles of association filed with the memorandum provide (Clause 51) that the original capital shall be divided into 500 preferred and 500 deferred shares, the preference shares to have priority over the deferred shares to the extent provided by the articles. The deferred shares were to be allotted *as fully paid up*, to Messrs. Whitley and Norton, pursuant to the agreement to which we have referred, in consideration, we presume, for the goodwill of the scheme. All further shares which may be created under the powers to increase capital, it is agreed, shall be divided in the same proportion into preferred and deferred shares, and all such deferred shares are to be allotted to Mr. Whitley and General Norton as *fully paid up*, also, we presume, as further consideration for goodwill. The borrowing powers of the company are to be exercised only with the consent of Mr. Whitley and General Norton (Clauses 58, 59), and debenture bonds may be issued at a premium or discount. The articles further provide (Clause 99) that, until the company shall be wound up, Mr. Whitley shall be "Director-General and Executive Commissioner," with a salary of not less than £1500 a-year. In addition he is to be chairman of the "Executive Council." Mr. Applin is appointed secretary to the Company at a salary of not less than £350 per annum, and General Norton is to be secretary at the Exhibition, for which he is to receive £1000 a year. All these salaries are to be paid by monthly instalments. In addition to the above remuneration, it is provided that a lump sum of £5875 is to be paid forthwith to Mr. Whitley and General Norton as the agreed amount of remuneration, and of office rent, salaries, wages, and disbursements, &c., in connection with the scheme anterior to the incorporation of the company. How this amount is ascertained does not appear, and we do not know. As our readers are no doubt aware, yearly returns have to be made of the shareholders of limited companies and number of shares issued, with the amounts called up on the shares. We find, therefore, that up to the 15th May, 1885, 650 shares were taken up, on which £58,570 was represented to have been paid, though from this sum £50,000 should be deducted as representing the 500 deferred shares only *nominally* "paid up," and £2830 was represented as unpaid at the date of the return.

On the 14th January, 1887, 996 shares had been taken up, on which calls to the extent of £37,703 6s. 8d. had been paid on the preferred shares and £11,896 13s. 4d. was still due. The deferred shares are dealt with as representing £50,000 "considered as paid." It should be said that on the 15th January, 1887, the nominal capital of the company was increased by £50,000, represented by 5000 new shares, 2500 of which, under the agreement, would, we presume, be given as paid-up shares to Messrs. Whitley and Norton. By this last return the largest shareholder is still Mr. Whitley, who is given as holding 597 shares. The next largest is Mr. Russell, of Boston, Mass., with 100; then follow Mr. F. L. Ames, of Boston, Mass., 70; Mr. Farrington, 50; Mr. Hy. Wynne. of 7, Poultry, 50; Mr. Thornton, Chislehurst, 30; Mr. Landreth, of Bristol, Penn,, 20; Mr. Hemenway, of Boston, Mass., 10; Mr. Carson, of Chicago, 10; Mr. Mackay, of 62, Wall-street, New York, 10; Messrs. Price and others, 10; Mr. Andrews, of New York, 5; Mr. J. Cunard, 5; Mr. Dayton, Cincinnati, 4; Sir Norman Pringle, 3; Mr. Price, 1, St. Helen's-place, London, 2; Prof. Skeat, 2; Mr. Sparhawk, Philadelphia, 2; and sixteen other shareholders of one share each. The original shareholders who started the company are returned thus:—Mr. Whitley, 597—including, apparently, the 500 deferred shares—Gen. Norton, none; Lord Ronald Gower, 1; Mr. Farrington, 50; Mr. Priestman, 1; Mr. Dorsey, 1; and Mr. Applin, 1.

The "Executive Council" are Lord Ronald Gower, Mr. Farrington, Mr. Priestman, Mr. Dorsey, Mr. Applin, Mr. Whitley, and General Norton.

As far as we are able to judge from the data given by the Company itself, the whole of the paid-up capital on the 14th January last was £37,703 6s. 8d., out of which will have been paid £5875 to Messrs. Whitley and Norton and all salaries due to them and Mr. Applin up to that period, as well as current expenses. The balance, even if eked out by payment of calls then unpaid, and increased by the £25,000 of new capital, should it have been subscribed, seems to us a very small sum to provide for the proposed building and necessary fittings for so ambitious an exhibition as its promoters have promised us. Such of our readers, however, who are interested in the matter, will be able to form an opinion for themselves, and each one by application at Somerset House, upon payment of one shilling, may have details which we have not considered it necessary to record here.

Delta Metal Valves.—The three following steamers were fitted with Beldam's corrugated valves in Delta metal:—s.s. Kent, after steaming 170,000 knots, the valves are still in good working order; s.s. Rewa, now on her eleventh voyage to Calcutta with the same valves; s.s. Sussex, the same valves have been in use for over two years, still in good working order.

MARRIOTT OGLE TARBOTTON.

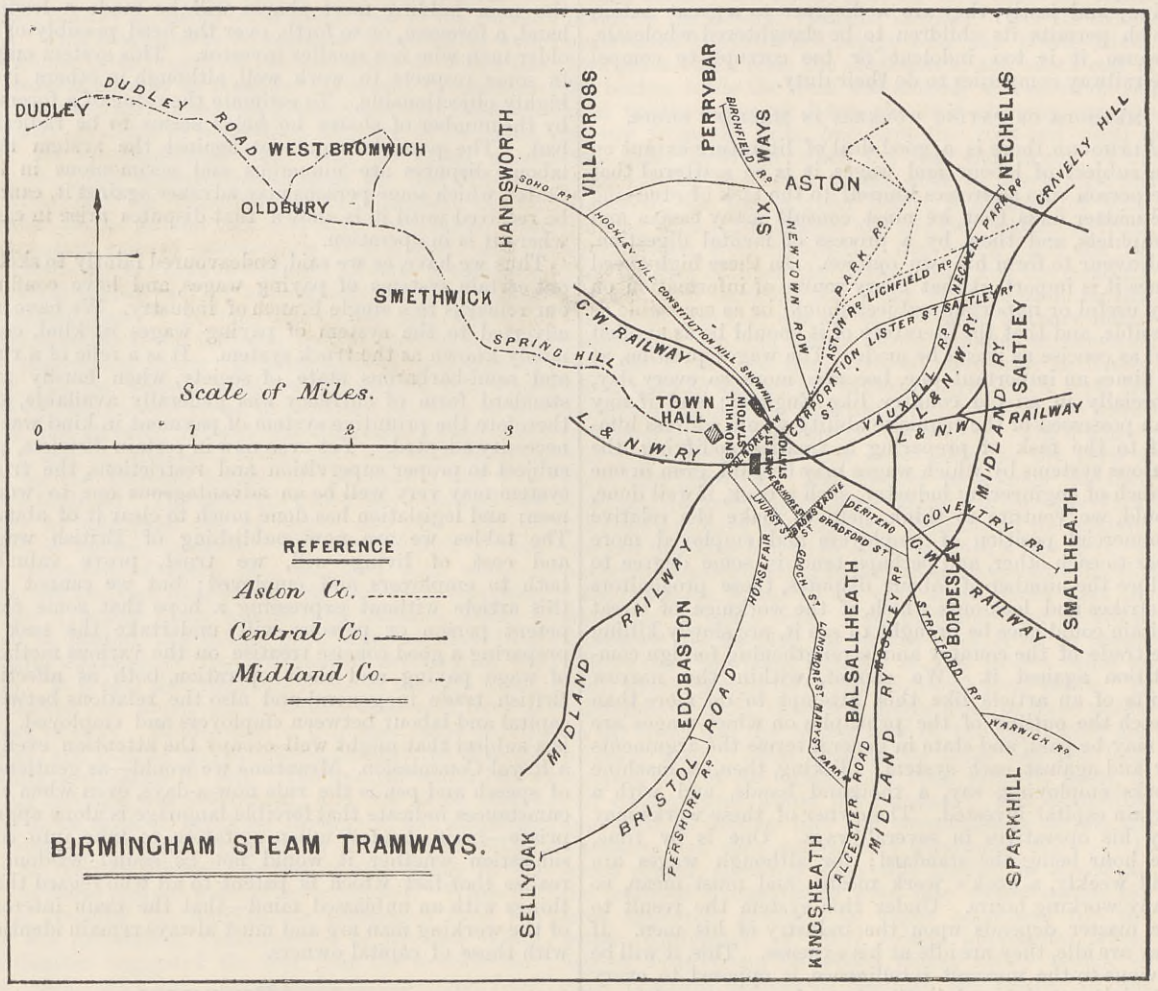
The death on Sunday last is announced of Mr. Marriott Ogle Tarbotton, consulting engineer to the Gas, Water, and Sewage Farm Committees of the Corporation of Nottingham. Mr. Tarbotton was born at Leeds on December 6th, 1833, and was the son of a cloth merchant of that town. He received his education at Leeds Grammar School, and adopting the profession of a civil engineer, became articled to Mr. Charles Clephan, C.E., of Wakefield, to whose practice he subsequently succeeded. In 1855, he was appointed borough surveyor at Wakefield, and in 1857 he married Miss E. M. Stanfield, of Wakefield, who survives him, together with two sons—one of whom at present holds a Government appointment in Canada—and two daughters. In 1859, the Nottingham Corporation appointed him surveyor. In the latter part of 1860 he prepared a report "upon the drainage above Nottingham, and on the whole question of the river Leen, the Tinker's Leen, and Meadows drainage." This was Mr. Tarbotton's first great undertaking of importance in Nottingham, and the report was exhaustive and convincing, and led to the introduction of a system of drainage which has since largely conduced to the health of the inhabitants residing in the low-lying part of the town, besides preserving the river Trent from becoming little short of of a huge open sewer. The new and elegant Trent Bridge was erected from Mr. Tarbotton's design, and opened in July, 1871. In 1872 Mr. Tarbotton became engineer of the Nottingham and Leen District Sewerage Board, and evolved the elaborate system of drainage which has proved so beneficial to the town, in addition to which he had control of the whole of the works connected with that great and expensive scheme. When the Corporation had it in contemplation to acquire the gas and water undertakings, Mr. Tarbotton was instructed to inquire into and report upon both matters, and it was, relying largely upon his advice and assistance, that the Town Council became proprietors of the gas and water. Shortly after commencing his connection with Nottingham, Mr. Tarbotton instituted a system of taking regular meteorological observations, which has been continued ever since, with the result that reliable and valuable data have been formulated concerning the weather, rainfall, and natural phenomena of the locality. The University buildings in Horsefair Close are built very much upon the plans and after a design submitted by Mr. Tarbotton to the Town Council for public offices and municipal buildings; in fact, his handiwork can be traced in most of the great improvements which have marked the development of Nottingham during the last twenty years. In 1880 the growth of the town and the magnitude of the gas, water, and sewage farm concerns made it imperative to reorganise the Borough Engineer's department, and Mr. Tarbotton was appointed consulting engineer to the Corporation. During the last seven years he has devoted his energies mainly to developing the capacity of both the gas and water undertakings, in order that they might keep ahead of the requirements of a rapidly increasing population. The new pumping station at Papplewick was perhaps the greatest of Mr. Tarbotton's engineering achievements, although the construction of the reservoir at the top of Park-row and the erection of the huge gasometer at Radford were works of considerable magnitude and difficulty. All of Mr. Tarbotton's work was good from an architectural point of view. He was essentially an artistic engineer, and left nothing behind him crude or æsthetically imperfect. The Papplewick pumping station, which he completed a week before his death, is on a classic model. He was a member of the Institution of Civil Engineers, an accomplised scholar, and a refined gentleman, and is sincerely regretted by all who came in contact with him to whom these qualities appealed.

Locomotive Engines on the South-Western Railway.—With regard to the new engines, we may supplement the information we gave last week, that they were designed to meet the increased weight of the trains caused by the replacement of old coaches by vehicles of greater carrying capacity. The new carriages are 18 per cent. heavier than those of Mr. Beattie's time, and the modern 7ft. 1in. and 6ft. 7in. express engines haul from fifteen to nineteen coaches without the assistance of a pilot, whereas in the old days very few of the main line express trains left Waterloo without two engines, which, of course, added considerably to the expenses of the locomotive department. The average speed of the fastest train is 44½ miles per hour.

The Late Sir W. P. Andrew.—Sir William P. Andrew, C.I.E., of St. Bernard's and Chalesfield, whose death in his 81st year occurred on Friday last, was born in Aberdeenshire, and was educated at Edinburgh and Oxford. Sir William Andrew's career began in this country more than forty years ago by the publication of a work on Indian railways, which was dedicated to the Court of Directors of the East India Company, and allowed his capacities for engineering to become known. He served in early life for a short period in India and submitted to the Home Government his schemes for the defence of India, which afterwards met with approval. He was founder of the Scinde, Punjaub, and Delhi Railway Company, and took an early and prominent part in promoting railway and telegraphic communication with India. Among the works of which he was the author were "Indian Railways," 1846; an essay on the Scinde Railway in relation to the routes to India. In 1856 he concluded an arrangement with the Home Government for the establishment of telegraphic communication with India, and in the following year he advocated on strategic grounds the construction of lines to the Bolan and the Khyber. In 1873 he led the discussion on the question of the gauge of Indian railways—a subject he had already treated in pamphlets—at the meeting of the Institution of Civil Engineers, when a resolution in favour of his views with regard to a gauge of 5ft. 6in. was passed by a large majority ("Proc." Inst. Civ. Eng., vols xxii., xxxiii., and xxxv.). In treating of the connection of the Khyber and Bolan Passes with the railway system of India, the *Times*, October 13th, 1878, said:—"Had the views so persistently advocated by Mr. Andrew, repeatedly brought forward by us, been adopted at the commencement of the struggle last October, as we then ventured to insist upon, vast sums would have been spared in the hire of transport, and we should have been spared the ignominy of feeling that a British army, nominally on active service, has occupied five weeks in covering less than seventy miles." The great scheme of Sir William Andrew's life was the Euphrates Valley Railway; and though he failed in recommending this project, the impetus he gave to railway communication in India may be estimated from the fact that in 1848, before a mile of railway was open, the external trade of India was £25,000,000; in 1883, with 10,000 miles of railway, the external trade was £147,837,920. He never ceased, from 1856 to the day of his death, to urge the advantage of the Euphrates Valley line as an alternative to that of the Red Sea. In 1879 Sir W. Andrew was chairman of the Stafford House Committee for promoting the construction of a railway from the Persian Gulf to Constantinople and the Mediterranean. Sir W. Andrew to the last took an interest in everything relating to the East, and he was a Fellow of many scientific societies. He was knighted in 1882, when he received the Companionship of the Order of the Indian Empire. He married, first, his cousin, Alice, daughter of Captain Andrew—she died in 1840—and, secondly, in 1843, Anne, daughter of Mr. Raeburn.

BIRMINGHAM STEAM TRAMWAYS.

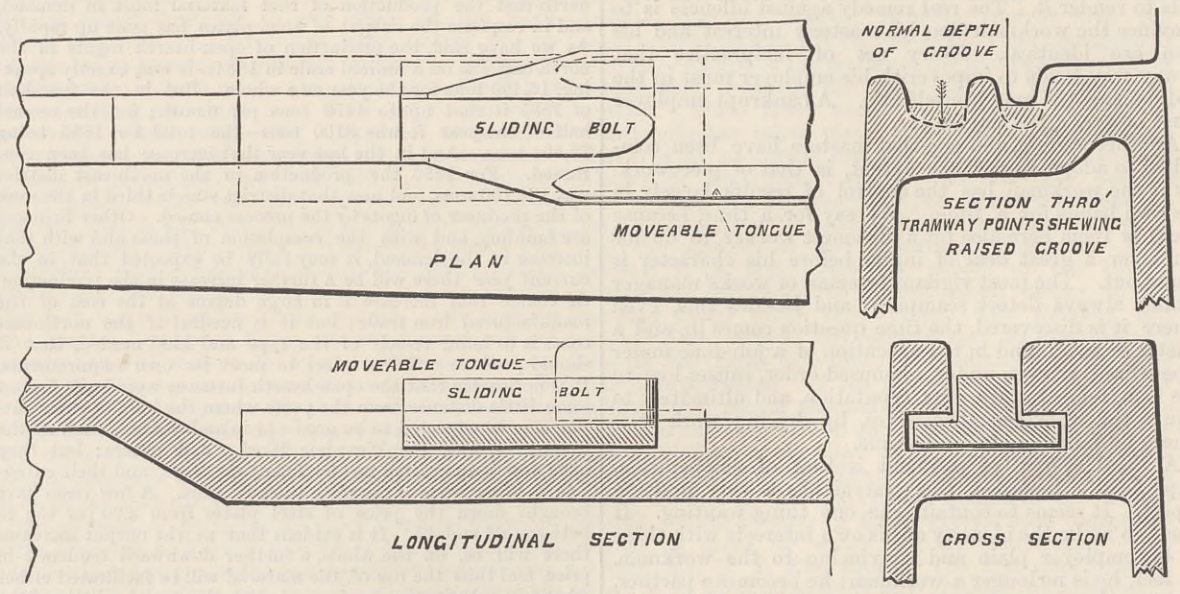
While visiting the works in connection with the Birmingham meeting of the British Association, last year, we frequently availed ourselves of the many lines of tramway worked by locomotives, principally those of Kitson and Co., and were much struck with the smartness of the working, the absence of nuisance, and the lowness of the fares. Through the introduction of the inspector of steam tramways to the Corporation, Mr. Henry J. T. Piercy, we have been put in direct communication with the general managers and engineers of the several companies, who have put complete information at our disposal, so that we are enabled to lay before our readers a tolerably comprehensive account of the working by steam of the Birmingham tramways. Out of fifty miles of tramway in and about the town, thirty-three are worked by steam, at a profit to the shareholders and with great convenience to the inhabitants generally, while the very few accidents recorded were such as would have happened with animal traction, the companies being fully exonerated from blame. Three companies, known generally as the Aston, the Central, and the Midland, work the whole or part of their lines by that which is, up to the present time, the cheapest of all tractive as it is of motive power.



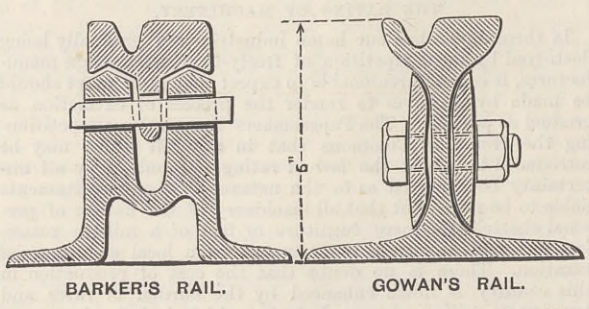
GENERAL PLAN.

The accompanying plan shows the tramways worked by steam in and around Birmingham, the longest being that of the Midland Tramway Co., extending as far as Dudley, with a loop to West Bromwich. A uniform gauge of 3ft. 6in. has been adopted throughout the Birmingham tramway system. The lines are worked in penny stages, the conductor collecting separately for each stage; and the cars seldom carry much less than their full complement of passengers,

The Aston Company.—The Birmingham and Aston Tramways Co. takes precedence as being the oldest in the field, and having, indeed, originated steam working in the Midlands capital. This company has also achieved the greatest financial success of any in the world, having carried about twelve million passengers since it began working at the end of 1882, and having already repaid in dividends about 60 per cent. of the capital, while £5 shares now realise £12. The current working expenses, including driver and conductor, are only 4d. per car per mile, or a little over 8d. when taking into account interest on capital, depreciation and sinking fund, the whole working expenses only amounting to about 53 per cent. of the receipts. This company was originally promoted by Mr. Charles Allarton Edge for working on his grooveless rail system, which was illustrated in The Engineer of 30th January, 1880. Having barely escaped a fatal accident from his cab's wheels engaging in the grooves of the Camberwell tramways, Mr. Edge invented a wheel which projects pins into holes in the grooveless rail after the manner of feathering floats in a paddle wheel. A two-mile line in Germany was worked on this system with technical success for nearly two years, but in the face of financial failure, Mr. Edge, still engineer to the company, abandoned the grooveless rail for the Aston line, although it had been sanctioned by the Town Council. The Aston line, from Old-square, Birmingham, to beyond Aston Park, shown by plain dotted lines on the general plan, has 6½ miles of route and 9 miles of single way, with a maximum gradient of 1 in 11 for a short distance and 1 in 14 for a quarter of a mile, the sharpest curves having a 40ft. radius. The way was originally laid with Barker's rolled steel rails, of which a section is appended; this stood very well for horse traction, but was more severely tried by steam working. About half the line is now laid with Gowan's grooved girder rail, of which a section is also appended, of 66 lb. or 88 lb. per yard, according to the traffic. For the 88 lb. rail the fish-plates are 1ft. 6in. by 4in. by ½in., with four holes for ¾in. bolts. The whole way is laid in concrete with light cross ties and no timber. There are triangles for turning at both ends of the route, so as to save the necessity of uncoupling. The sketches above give a section through the points showing raised groove on which the wheel flanges mount, and also details of the movable tongue with sliding bolt for locking it in the desired position. Both these improvements, which have been devised by Mr. Edge, are found to give excellent results in practice. The line is worked by engines for the whole length, with the exception of a short feeding section worked by horses. All the engines are by Kitson, of Leeds, with air condensers on the



DETAILS OF EDGE'S TRAMWAY POINT.

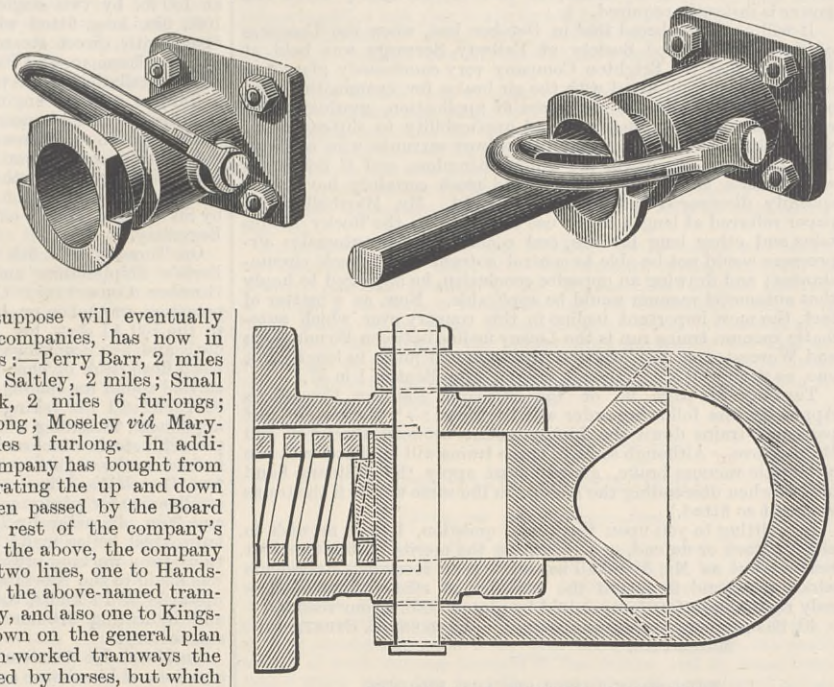


BARKER'S RAIL. GOWAN'S RAIL.

roof, and the latest improvements. They are driven by one man only, the conductor looking after the car. The cars, by Starbuck and Co., of Birkenhead, carry sixty-two passengers, viz., thirty inside and thirty-two on the top. Outside passengers are protected from the sun and dust, and in a great measure from rain, by a roof. The platforms are set 4in. lower than those of the other companies, thus giving an additional 4in. height to the roof without diminishing from the height of the body. This is a judicious improvement, for it must be admitted that the roofs of Birmingham cars generally are so inconveniently low as to make the taking of one's seat a matter of some difficulty, especially when having to pass sixteen other passengers. The cars are also 6ft. 3in. wide, whereas those of the other companies are only 5ft. 9in. A 2½ minute service is given during the busy part of the day. The fifth annual report, bringing the accounts to June 30th last, shows that the receipts for the year amounted to £17,971, and the total expenses, including depreciation, to £11,961, leaving a balance of £6010, which permitted of 10 per cent., free from income-tax, being divided. The engine miles run were 286,528, and the passengers carried 3,095,540.

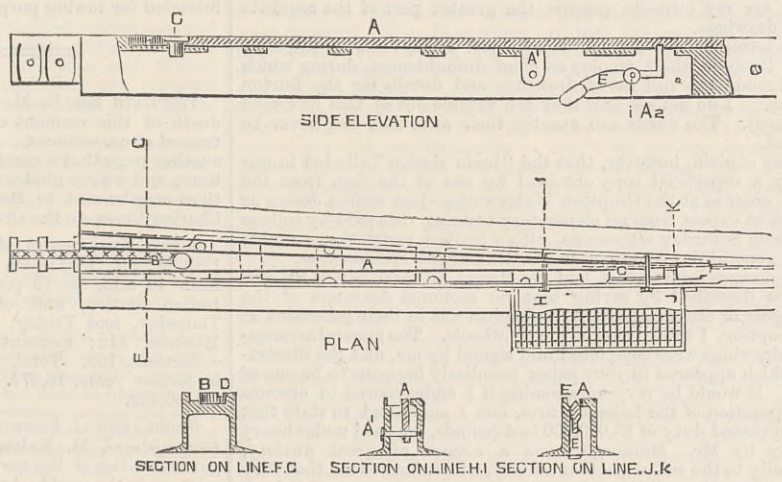
The Central Company.—The Birmingham Central Tramways Company, which there is every reason to suppose will eventually annex the systems of the other two companies, has now in operation by steam the following lines:—Perry Barr, 2 miles 4 furlongs; Lozells, 2 miles 1 furlong; Saltley, 2 miles; Small Heath, 2 miles 5 furlongs; Sparkbrook, 2 miles 6 furlongs; Moseley *viâ* Camp-hill, 3 miles 1 furlong; Moseley *viâ* Mary-street, 2 miles 4 furlongs; total, 17 miles 1 furlong. In addition to these tramways the Midland Company has bought from the Aston Company a loop line for separating the up and down traffic on the Saltley line. This has been passed by the Board of Trade for steam working with the rest of the company's tramway system. Also, in addition to the above, the company has arranged to work by running cable two lines, one to Handsworth and the other to Selly Oak. All the above-named tramways, belonging to the Central Company, and also one to Kingsheath passed for steam working, are shown on the general plan by full single lines. Besides its steam-worked tramways the company has four lines at present worked by horses, but which will, there is little doubt, be eventually worked by steam. It has also bought up the omnibuses on a dozen lines, thus converting opposition into an auxiliary. The lengths of tramway now in operation, reduced to single lines, are:—Steam traction, 20 miles 5 furlongs 2·6 chains; horse traction, 15 miles 4 furlongs 0·6 chains; over other companies' lines, 7 furlongs 3·7 chains; total, 37 miles 6·9 chains. The way is laid entirely with Gowan's grooved girder rail, 7in. high, and weighing 98 lb. to the yard, laid in concrete with cross ties and without any timber. Mr. E. Pritchard is engineer of the lines, and Mr. Charles J. Nicholson resident engineer and general manager. His movable point, shown by the annexed illustration, is used throughout. The loose movable tongue A is secured by the cap piece B in its place on the radius pin C; while D is a wedge, driven between the cap piece and the body, for keeping the latter in position, and E a locking latch to ensure the tongue remaining in its proper position during the passage of the engine and car. A^1 is a bolt to prevent the tongue from rising off its seat; and A^2 the radius pin on which the locking latch rises and falls. The tongue may be taken out readily for repairs and renewal without removing a single sett, all that is required being to withdraw the bolt, drive out the wedge, and lift off the cap piece. The locking arrangement holds the tongue in position during the passage of the vehicles, thus preventing them from taking the wrong roads. This point, which may be made in any length and adapted to any section of rail, is constructed by Messrs. F. H. Lloyd and Co., of Wednesbury. Thanks, in a great measure, to this point, thirty-one engines and cars are got out of the running sheds in 1 hour 7 min., including coupling. The rule for laying points is the same as the English rule of the road. If running on a curve to the left the loose point should be on the right, and *vice versâ*, because the tread of the wheel passing over the loose point holds it down with the weight of the vehicle. The lines are laid out for steam working, which was begun in December, 1884, but the arrangements for comprehensively working the whole system will not be complete for another six months. At present over a hundred vehicles are out every day, of which more than fifty are engines by Kitsons, Beyer and Peacock, and the Falcon Carriage and Engine Works, Loughborough. They are all direct-acting, with air condensers and water tanks, the drivers, about fifty, being all Manchester, Sheffield, and Lincolnshire Railway men.

Mr. Nicholson's patent coupling was described and illustrated in The Engineer of 23rd January, 1885, but it has since been so improved and simplified that we now illustrate its present form in the positions of coupled and uncoupled, with a section through the buffer. The buffer has a concave surface, as before, to receive the conical end of the draw-bar, but the drag-link is supported on a stop formed by partially cutting away the flange of the buffer. The weight of the drag-link is found sufficient to keep it in its place, because it is always in tension while subject to shocks. The sixty cars were built by the Falcon Company, some of them being "garden-seated" on the top that is to say, the seats are placed transversely and have reversible backs. Mr. Nicholson has originated a very useful measure in tramway working by providing the cars with a gigantic letter, indicative of the route, so that the several cars can be distinguished from a distance. Some lamps are also being constructed for carrying out the same idea at night. These lamps, and also those of the railway type by which the cars are lighted, will be supplied by Pope's gas, the plant for generating which and compressing the atmosphere is now put up at the depôt, of which a plan and description are given below. In the case of cars which do not run to the principal depôt a fourteen hours' or two working days' supply will be sent along the line in plate iron reservoirs like egg-ended boilers. Where possible the company arranges for subsidiary depôts at all the

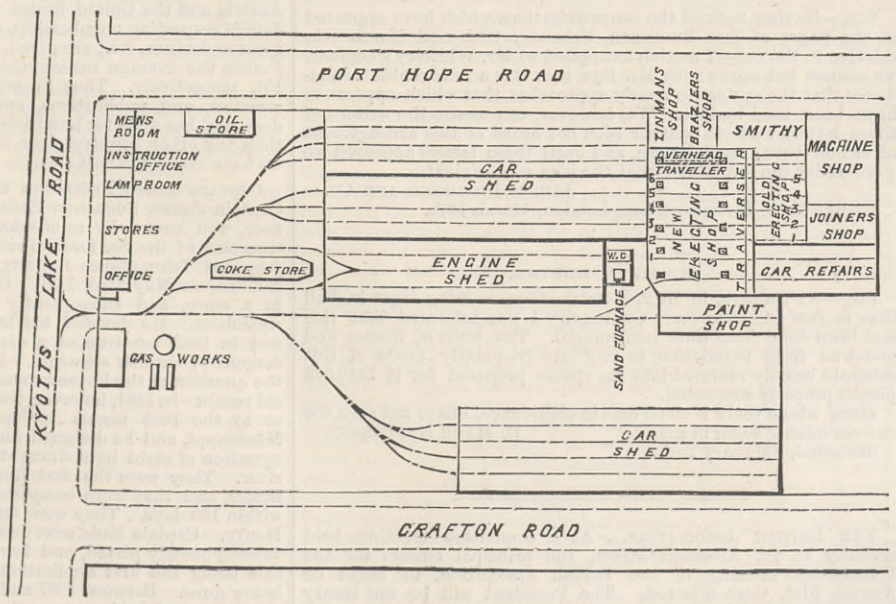


NICHOLSON'S BUFFER COUPLING.

outlying termini, as they are found very convenient for keeping the mess of oiling, &c., out of the public thoroughfare. Triangles are employed for turning when it is not possible to run round. At Moseley the cars run round the village green. A regular service varying with the importance of the traffic is given on each line throughout the day, and it is found that a regular, steady traffic is developed progressively. During the week ending 4th September, by no means a specially busy week, the average service on all the steam-worked lines was 15·87min.; and 16,924 car miles were run.



NICHOLSON'S MOVABLE POINTS.



CENTRAL COMPANY'S MAIN DEPOT.

The principal depôt, a plan of which is appended, covers about two acres of ground, and will eventually provide running accommodation for sixty-four cars and seventy engines, as well as a repair shop. Mr. Nicholson does not trust to spare parts, because, if they are made to template for a new engine, they will not fit an engine that has been running six months. Accordingly, plant is laid down for doing all possible repairs to the engines, so that even a new engine could be turned out if it was worth while. Besides the smithy and machine shop, there is an erecting shop with overhead traveller and pits for seventeen engines. There are two of Onions' patent forges of the cast-iron portable type, and a 56lb. Massey steam-hammer, capable of drawing down a 3in. square bar. A hydraulic press has been put down for forcing wheels on their axles. Tires are heated by a special gas stove for being shrunk on the wheels, an operation which is performed from first to last in twenty minutes. Some wheels are now being made in which the treads are rolled on the rims. Some new engines are provided with water governors, which are to be fitted to all engines as they come in for repairs. The gudgeon pins are forged on the small ends of connecting rods at the depôt, thus ensuring trustworthiness. Brasses that have become worn are done up by running into them Richards' white metal, which is plastic when hot, and has given excellent results. Glands are also rebushed with this metal, which, when worn, can be simply melted and recast by labourers. The depôt is well laid out, and must conduce greatly to the efficient working of this extensive tramway system.

The total expense for engines last year was 5·1d. per tram mile, fuel costing 1·52d. per tram mile. The total expenditure was 8·99d., which is to be reduced during the present year to 8·15 per tram mile. The former figure is about 1½d. higher than the cost of working the Aston system; but the receipts are also correspondingly higher. The difference in cost arises from the higher wages paid by the Central Company. At the last annual meeting Mr. Pritchard, who is chairman of the Aston Company and engineer for the Central Company, observed that the low working expenses of the former company were largely due to the efforts of a director, Mr. Wilson, who was consequently asked to accept a seat on the Central board.

The Midland Company.—The Birmingham and Midland Steam Tramways—the title adopted by this company—constitute a light or secondary railway, extending, as they do, from Summer-row, near the Town Hall, Birmingham, to Dudley, a distance of eight miles, with a loop to West Bromwich, two and a-half miles long. The track is laid with grooved girder rails, and there are eighteen engines, by Kitson; six by Thomas Green and Sons; and twenty-three cars, some holding thirty in and thirty out, made by the Oldbury Carriage Company, and others, holding thirty in and thirty-two out, made by the Starbuck Carriage and Wagon Company, of Birkenhead. A seven minutes' service is now afforded after noon, the traffic having been greatly developed since working was begun in 1884. During the year ending June 30th last, 201,784 engine miles were run, and 3,022,232 passengers were carried. The total receipts were £13,247, and the expenditure, including depreciation, was £9747, permitting of a 5 per cent. dividend.

MAGNESIA IN PORTLAND CEMENT.

In a recent discussion on "Concrete Works for Harbours," at the Institution of Civil Engineers, mention was made of the presence of magnesia in cements, and the danger incurred by structures built with a material in which it is present to any except the smallest extent. There is no doubt that magnesia is frequently present in cement, and that as its dangerous properties cannot be got rid of in the ordinary process of manufacture, care must be taken to prevent an excessive quantity being present in the cement. But this can be done by a thorough process of testing, such as all manufacturers use more or less, and all engineers should use thoroughly; and if Sir John Coode's or Mr. Faija's system of testing be employed, the safety or the danger of the cement for constructive purposes will be proved in forty-eight hours. The chemical cause of any failure will not be shown, but if it can be demonstrated that the material can or cannot be safely used in concrete or buildings, this is all that is necessary for practical purposes. The disintegration of cement, or cement mortars, or concrete, may be caused—and no doubt is frequently caused—by the presence of free lime, which, if in excess, will produce expansion and destruction in the same way as is the case when an excess of magnesia is present, though from different causes. In volume lxxxvii. of the "Proceedings" of the Institution of Civil Engineers, at page 462, will be found a paper describing failures in works built with cement containing magnesia to the extent of from 16 to 28 per cent.

The demand of engineers for higher and higher tests for Portland cement tend to produce a highly limed cement, and so increase the danger of the presence of free lime; and if this demand is to continue—and there seems to be no present sign of any abatement in it—the test must be more and more carefully carried out, otherwise it is certain that many structures will be built with material which has the elements of destruction in it. It was mentioned in the discussion referred to above that the usual size of briquette used is that having a section of 2¼in. This is, however, scarcely the case at present, the briquette of 1in. section having come into almost universal use on account of its increased handiness, the ease with which a large number of moulds can be filled from one gauging of cement—in itself a great advantage—and the much smaller space occupied by the briquettes both in the bath and when stacked for reference. If the maximum tensile test required were not more than 750 lb. on the 2¼in. section, or 333 lb. per square inch as stated in the discussion referred to, there would be no difficulty in meeting the demands of engineers, and at the same time guaranteeing a perfectly sound and safe cement which would increase greatly in strength with age; but unfortunately tests of 450 lb. to 500 lb. per square inch are frequently asked for, and as these are minimum tests it is necessary to provide a material which shall have, as a rule, a considerably higher strength; and it is not unusual to find cement that gives a result of 700 lb. per square inch at seven days after gauging, and even higher tests are sometimes produced up to 1000 lb., and the material from which these samples are made is generally found to be free from danger. But the risk in the manufacture of a cement to stand such a high test is much greater than when a moderate test is required, and whereas the cement of comparatively low initial strength will certainly increase very considerably in value with age, that having a high initial value will not increase much in strength with age, and will, not unfrequently, lose in strength after a moderate period of time has elapsed; and it is a question worthy of careful consideration whether it is better to secure a high initial strength with a possible and probable reduction of that strength in the future, or to be satisfied with a lower initial strength, say 380 lb. per square inch, with a large increase of permanent strength to come. The proportions to be used in the mixing of cement must depend largely on the nature of the materials at hand, and should be tested by experiment, but as the object to be aimed at in the use of sand is to fill up vacant spaces with a mortar strong enough for the purpose, the amount of such vacant spaces should be tested in several samples by filling a measure with the broken stone, gravel, slag, or whatever material is to be used, and adding water until the measure is quite full; then the measure of the water will represent roughly the measure of the sand and cement to be added, and if the quantity be large in proportion to the whole it is obvious either that the material must be changed or an increased proportion of cement used.

LETTERS TO THE EDITOR.

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

CYLINDER CONDENSATION.

Sir,—In reply to the inquiries of your correspondent "X.," I of course assume that the steam does work in expanding; the results would be quite different if this were not the case. If "X." will refer to my letter of February 4th he will find that I do not state that condensation, re-evaporation, and re-condensation, again take place; my words were as follows:—"It will be seen that in expanding from 7 to 4 atmospheres re-evaporation takes place"—water being already present, owing to condensation during the admission period, or priming, or both—"On further expansion to 1 atmosphere there is re-condensation to the original value $x_1 = 0{\cdot}513$."

In my last letter of March 4th I stated that in the cases where there were evaporation and re-condensation—when the proportion of steam to water was near 0·5—the deviation from the initial value of x was very small, so that to any ordinary scale the adiabatic curve would be scarcely distinguishable from the curve for a constant proportion of steam to water, and for that reason I did not draw it; the values of x under these conditions are, however, given in the calculated tabular statement in columns 4 and 5, and the specific volumes can easily be found from them for any given pressure.

$$\text{Specific volume} = x \times \left\{ \text{Specific volume of dry steam} - \text{volume of 1 lb. of water} \right\} + \text{volume of 1 lb. of water.}$$

The two curves shown in my previous letter bear on the question in so far that they are the two extremes of the series of adiabatic lines for steam and water. In the one instance pure steam only is initially present, in the other only water. For any other given initial condition, any point of the curve is easily constructed from the two curves shown, as follows: a [1] horizontal straight line intersecting both curves is drawn, and the portion between the points of intersection is divided by the required point in such a manner that the distance between the latter and the curve for water only being initially present, bears to the whole distance between the points of intersection—measured on the line—the ratio x. For example, suppose a point of the adiabatic curve for an initial value of $x_1 = 0{\cdot}5$ is required; a line is drawn parallel to the co-ordinates on which the volume is measured, intersecting the two curves respectively in A and B, the required point P will halve the distance A B. If $x_1 = 0{\cdot}75$, then A P : A B = 0·75.

Roughly speaking, within the pressures given the curve $x_1 = 0{\cdot}5$ forms a sort of boundary, on one side of which there is evaporation, on the other condensation during expansion. In no case, however, does the adiabatic curve absolutely coincide with the curve for a constant proportion of steam; but it approximates very closely to the latter when the initial value of x is near $\frac{1}{2}$. G. R. Bodmer.

14, Delahay-street, Westminster,
March 14th.

GRAIN DRYERS.

Sir,—It will probably interest your numerous readers, especially the agricultural engineers, to know that the Minister of Agriculture and Commerce of this country has issued a circular—a copy of which I herewith enclose you—inviting an international competition of machines for drying grain.

In the northern part of Italy the principal element of food of the agricultural population is either "polenta"—a kind of stiff maze pudding—or bread made from the flour of the Indian corn. This crop having to be harvested at a period of the year when dry weather is not to be depended upon, it results that the corn is often converted into flour in a damp state, rendering it very injurious to the health, and resulting in its being the principal cause of the dreadful disease called "pellagra," and it is mainly on this account that the Italian Government has promoted this competition.

A committee has been appointed for conducting the trials and awarding the 'prizes, which are four in number, and divided as follows, viz., two diplomas, each with 2000f. added; two diplomas, each with 500f. added. The Minister of Agriculture will also purchase two of the machines to which prizes shall have been awarded. As this is certainly not the only country where the want of such a machine is being felt, it seems to me that it should be very much in the interest of the British agricultural engineer to take this matter up and try what he can do to secure the trade.

The trials will take place within the grounds of the International Millers' Exhibition at Milan during the month of May next. The cost of the trials will be borne by the committee. No charge will be made for space, but exhibitors will have to pay for any fixing, should such be required, and deliver their goods free to the Exhibition. For the transport in Italy the Italian Railway companies will accord a reduced rate of freight. Applications for admission should be sent to the committee, at 21, Portici Settentrionali, Milan, before the expiration of this month, but it is possible that this time might be extended to foreign competitors.

With regard to the International Millers' and Bakers' Exhibition, to be opened in this city next May, it is much to be regretted that so few applications for space have been received from England. It has been warmly supported by the German, Austrian, and Swiss engineers, several of them having the intention to exhibit complete roller mills in actual work.

In Italy as well as in England the new system of roller grinding is being largely introduced, but I am sorry to say English engineers are doing very little if any of the work. As an adjunct to the Milling Exhibition, there will be an Exhibition of Electric Lighting and of machinery or apparatus connected therewith. Milan is, I believe, already one of the best electric-lighted cities in Europe, not only as regards the street lighting, but also in its public and private buildings. Even its far-famed cathedral has just been lighted by the electric light. It therefore promises to be a very interesting Exhibition, and should be worthy the attention of the English electrical engineers.

Milan, March 12th. John Whitmore,
British Vice-Consul.

RAILWAY BRAKES.

Sir,—In last week's Engineer, under the heading of Railway Matters, the fact was recorded that on Wednesday, the 9th inst., a paper was read on "Railway Brakes" before the Society of Arts, by Mr. Marshall. Some portions of the paper relating to the progress of the brake question were interesting and instructive, and there can be no doubt that the author was perfectly correct when he came to the conclusion that of all the brakes described there are but two worthy of consideration, namely, automatic air pressure and automatic vacuum; but when he commenced to compare the merits of these two "best" systems, he appeared to take for granted certain statements and theories, and then to build upon this erroneous foundation further theories, and ultimately deduced a series of conclusions having for their object an attempt to prove that automatic vacuum was the best medium for working brakes.

Mr. Marshall having described the construction of each system, assumed, without producing a particle of evidence, that automatic air and automatic vacuum brakes were equal as to the time required to put them on. I was not called upon to take part in the discussion, but if the opportunity had been afforded I should have been somewhat inclined to doubt the fact. Having been present at nearly all the important brake experiments in this country during the past eighteen or nineteen years, I can safely say that I have never found a brake so prompt in action as the Westinghouse; and when it is remembered that an express train running at sixty miles an hour is passing over 88ft. per second, it will be seen that one second of time, or even a quarter of a second, in the quickness of application may make all the difference between life and death. Passing on to the triple valve, Mr. Marshall assumed that it does not work as it is intended; in short, to quote the words of Mr. T. E. Harrison in his report, Mr. Marshall attempted to make it the bugbear of the air-pressure system, yet in actual practice, and as a fact, the triple valve gives as little or even less trouble than any mechanical apparatus on a railway.

Mr. Marshall next proceeded to inform the members of the Society of Arts that the automatic air brake could not be regulated, it must be put full on, and taken off, and put on again. Now it is not necessary for me to tell the readers of The Engineer that the brake can be and is regulated on every train upon which it is used—except, of course, in case of emergency when full power is instantly required.

It will be remembered that in October last, when the Congress of the Amalgamated Society of Railway Servants was held at Brighton, that the Brighton Company very courteously placed at our disposal a train fitted with the air brake for examination, and all the points relating to quickness of application, graduation, or regulation, time of releasing, and applicability to slip-carriages, were fully tested by sixty practical railway servants who came as delegates from all parts of the United Kingdom, and if defects or weak points had existed they would most certainly have been speedily discovered and brought to light. Mr. Marshall in his paper referred at length to the use of brakes on the Rocky Mountains and other long inclines, and considered the automatic air-pressure would not be able to control a train under such circumstances; and drawing an opposite conclusion, he appeared to imply that automatic vacuum would be applicable. Now, as a matter of fact, the most important incline in this country over which automatic vacuum trains run is the Lickey incline between Birmingham and Worcester on the Midland Railway, two miles in length, not one, as stated by Mr. Marshall, and on a gradient of 1 in 37.

Turning to page 93 of the Midland Railway Company's Appendix, the following order will be found:—"Working of fast passenger trains down the Lickey incline between Blackwell and Bromsgrove. Although some of these trains will be fitted with the automatic vacuum brake, guards must apply the ordinary hand brakes when descending the incline, in the same way as if the trains were not so fitted."

In writting to you upon the brake question, I have no wish to either attack or defend, or to compare the merits of the two best brakes; but as Mr. Marshall has made some incorrect statements which may tend to retard the adoption of efficient brakes, it is only right that a few facts should be placed before your readers.

40, Saxe-Coburg-street, Leicester, Clement E. Stretton.
March 12th.

BURTON-ON-TRENT SEWAGE ENGINES.

Sir,—Pardon me troubling you again for space in order that I may reply to Messrs. Gimson. In my first communication I was content to suggest that one or two atoms of credit were due to me concerning the construction and ultimate economical working of the Burton-on-Trent sewage engines. My humble claim has been replied to, and it is on this account that I crave your indulgence. Messrs. Gimson observe that after a "main design" had been accomplished by them, I was engaged under their *guidance*—the italics are my own—to execute the greater part of the requisite detail drawings.

In a letter I have by me, dated April 22nd, 1886, they specify that I "was in their employ as chief draughtsman, during which time I made the full set of drawings and details for the Burton engines." I do not see how they can wriggle out of this awkward statement. The words are exactly their own, and can never be recalled.

I may explain, however, that the "main design" alluded to was merely a superficial copy obtained by one of the firm from the Woolf engines at the Cropston Waterworks—just such a design as one might expect from an elementary training visit paid by college youths on Saturday afternoons, with a limited restriction, suitable to the generalities contained in Mr. Mansergh's specification.

The meagre information laid by Messrs. Gimson before me can best be described by saying that no sectional drawings of the valve gear or other important mechanism was in their possession at all excepting, I think, that of the fly-wheels. The general arrangement drawings were completed and signed by me, and the illustration which appeared in your paper peculiarly happens to be one of them. It would be very unbecoming if I endeavoured to obscure the reputation of the Leicester firm, but I am bound to state that the stipulated duty of 85,000,000 foot-pounds, imposed under heavy penalty by Mr. Mansergh, was a source of great anxiety, especially to the senior partner himself, who informed me that they had not a vestige of data from previous experience to fall back upon. They were the first engines of the kind ever built by them, and the duty realised exceeded 100,000,000 foot-pounds. The real point at issue therefore is, did Messrs. Gimson bring about these satisfactory results? I leave the answer to your readers.

Smethwick, March 14th. W. Walker.

THE ELECTRIC LIGHT AT WHITELEY'S.

Sir,—Having noticed the communications which have appeared in the pages of The Engineer, February 25th and March 4th, relative to the cut-off motion as applied to Mr. Whiteley's engines, we cannot but agree with Mr. Rye that it is a remarkable coincidence that the system so nearly approaches that which appears to have been used by him. We, however, can assure the writers of these letters we have neither seen nor heard of this arrangement of cut-off being used before, and until these letters appeared we were under the impression that the idea was original.

Joseph Richmond and Co.

Kirby-street, Hatton-garden, London, March 10th.

SUGAR IN MORTAR.

Sir,—At Swatow, in 1872, I saw the Chinese using sugar in shell lime mortar and concrete. On inquiry I was informed that this had been done from time immemorial. The walls of houses and godowns from foundation to roof are frequently made of this concrete heavily rammed into the spaces prepared for it between planks properly supported.

Here, where there is stone lime in abundance, I have not seen the natives mixing sugar in mortar. D. Marr Henderson.

Shanghai, February 2nd.

The British Association.—At a committee meeting held recently at 22, Albemarle-street, the principal officers for the Manchester meeting of the British Association, to begin on August 31st, were selected. The President will be Sir Henry Roscoe, M.P., F.R.S. The presidents of the various sections will be as follow:—Section A, Mathematics and Physics, Sir Robert S. Ball, Astronomer Royal for Ireland; B, Chemistry, Dr. Edward Schunck, F.R.S.; C, Geology, Dr. Henry Woodward, F.R.S.; D, Biology, Professor A. Newton, F.R.S.; E, Geography, General Sir Charles Warren, R.E., G.C.M.G.; F, Economic Science, Dr. Robert Giffen; G, Mechanical Science, Professor Osborne Reynolds, F.R.S. For Section H, Anthropology, a president has not yet been obtained. The Manchester meeting promises to be one of the most brilliant, socially at least, ever held. A very large sum has already been subscribed, and the excursions and other entertainments will be on an unusually liberal scale. One of the public lectures will be given by Professor H. B. Dixon on "The rate of Explosions in Gases;" the lecture to the "operative classes" will be by Professor George Forbes.

[1] As published the diagram is shown at right angles to its proper position; the pressure measurements should be vertical

LAUNCHES AND TRIAL TRIPS.

The s.s. Era, designed by Sir E. J. Reed, and built and engined by Palmer's Shipbuilding and Iron Company, was tried, on the 10th inst., at the measured mile off the Tyne. The principal dimensions of the vessel are:—Length between perpendiculars, 271ft.; moulded breadth, 37ft.; depth of hold to main deck, 15ft. 6in., the vessel being built on spar deck rules. She has been built of steel to the highest class at Lloyd's, and is capable of carrying 2000 tons dead weight of oil below main deck. The pumping arrangements for delivering oil are very complete and fitted on main deck, the "Worthington plant" being capable of delivering 1000 gallons per minute. The engines are triple compound, with cylinders 21in. 34in., and 57in. diameter with 39in. stroke, steam being supplied at 150 lb. by two single-ended boilers, 12ft. 6in. diameter and 10ft. 6in. long, fitted with Foxe's furnaces. The vessel is also fitted with direct steam windlass and donkey boiler, both of Clarke, Chapman, and Parson's manufacture. There is also a complete installation of electric light with Holmes' dynamo, driven by a Tangye vertical engine placed in the engine-room. On the measured mile, on a mean of four runs, the vessel averaged 10·89 knots, with 73 revolutions and 26in. vacuum, developing over 1100 indicated horse-power on a load draught of 17ft. 5in. mean, there being a strong east-north-east wind and heavy swell. Mr. P. Hall was present on behalf of the builders, and the trial was conducted by Sir Edward Reed's officers, Mr. John Hudson and Mr. Robert Baggallay.

On Tuesday, the 8th inst., the s.s. Auckland, constructed by Earle's Shipbuilding and Engineering Company, Hull, for the Humber Conservancy Commissioners, for salvage and towing purposes, was taken on her trial trip. The vessel is built of steel to the 100 A1 class, her dimensions being 132ft. by 22ft. by 11ft. 6in., and her scantlings are considerably in excess of rule. She has a flush deck of chequered plate, and a strong wood belting is carried round for chafing. Large catheads are built into the ship at each end for taking heavy lifts, and she has other efficient appliances, including a steel foremast of large diameter and two powerful steam winches. A horizontal pump fitted as a fire engine is fixed in the engine room with deck connections, and she has also two Drysdale's 12in. centrifugal pumps and a portable one of smaller size for salvage purposes. The engines are compound, 18in. and 36in. diameter by 21in. stroke, supplied with steam from a large steel boiler made in accordance with the Board of Trade rules for a working pressure of 90 lb. per square inch. The run was made to the Newsand Light and back at an average speed of upwards of 10 knots, the engines working remarkably smoothly and indicating 370-horse power, which was considered highly satisfactory.

On March 1st the steam tug Midge, built by Messrs. Forrestt and Son, of Limehouse and Millwall, for the Crown Agents for the Colonies, went on her official trial trip at Long Reach, Greenhithe. The vessel is built of teak and is of the following dimensions:—Length, 48ft.; breadth, 10ft.; depth, 5ft. The engines are of the high-pressure type; cylinders, 8in. diameter with a stroke of 10in. Marine multitubular boiler. The mean speed attained on the trial trip was 9¼ miles per hour. Messrs. Matthews and Wingate, who represented Sir John Coode, expressed themselves highly satisfied with the speed, seaworthiness, and the high quality of the workmanship and material throughout the vessel. The Midge is intended for towing purposes at Castries Harbour, St. Lucia.

The Late Mr. R. M. Ordish.—We regret to hear that by the death of this eminent engineer his family has been left in distressed circumstances. It will be seen by an advertisement on another page that a committee has been formed to collect subscriptions, and we are glad to call attention to the fact that contributions may be sent to Messrs. Cocks, Biddulph, and Co., bankers, Charing Cross, to the Ordish Fund account.

South Kensington Museum.—Visitors during the week ending 12th March, 1887:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m.: Museum, 8652; mercantile marine, Indian section, and other collections, 3038. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 5 p.m.: Museum, 812; mercantile marine, Indian section, and other collections, 163. Total, 12,665. Average of corresponding week in former years, 16,274. Total from the opening of the Museum, 25,460,432.

Geographical Instruction.—In a recent number of *La Gazette Géographique*, M. Kaltbrunner published an article in which he gave statistics of the various societies for geography and the allied sciences in the world. According to continents, the number of these is as follows:—Europe, 91; Africa, 5; America, 9; Asia, 9; Australia, 2; giving a total of 115. France heads the list with 28, then comes Germany with 23, then Italy with 8, Switzerland with 7, Austria with 6, and Great Britain with 4. The total number of periodicals treating of geography as a principal or accessory subject is 263, of which 214 are published in Europe, 14 in Africa, 19 in America, 15 in Asia, and 1 in Australia. France again heads the list with 79, Germany has 42, Great Britain 18, Italy 13 Austria and the United States 11 each. Many other interesting details respecting membership, amount of subscriptions, of Government assistance, &c., are given. In Great Britain, Germany, and France the average subscriptions per member are 70f., 35f., and 15f. respectively. Thus France has a lot of geography-talking societies, and publications, and teachers. Great Britain, which does, and has done for hundreds of years, more practical geography than any other country, does it without these; or the few that we have are of the best sort.

Captain James Buchanan Eads.—The death is announced of Captain James Buchanan Eads, the distinguished American engineer, well known by reputation in this country through his construction of the St. Louis Bridge, his Mississippi works, and his proposed Tehuantepec Railway. He was born at Lawrenceburg, Indiana, on May 23rd, 1820. On leaving school he was employed in a store, and subsequently became a clerk on a Mississippi steamboat. He devoted his leisure to the study of engineering, and in 1842 constructed a diving-bell boat for the recovery of cargoes of sunken steamers. For nearly twenty years he studied the question of the improvement of navigation, but without practical result. In 1861, however, he was consulted by President Lincoln as to the best means for opening up the navigation of the Mississippi, and he designed and completed for the Government a squadron of eight light-draught ironclad vessels for service on that river. They were the first ironclads constructed by the United States, and they were completed and made ready for their guns within 100 days. They were first employed in the capture of Fort Henry. Captain Eads next designed and constructed six ironclad vessels, heavily plated, and having the turrets worked by steam, this being the first application of steam to the manipulation of heavy guns. Between 1867 and 1874 he designed and constructed the great steel bridge across the Mississippi at St. Louis. He was then intrusted with the important task of improving the channel of the Mississippi below New Orleans, which was seriously obstructed. In the space of five years, by his ingenious operations, he secured a channel 200ft wide and 26ft. deep, with a central depth of not less than 30ft. Captain Eads also advocated the application of the jetty system to the improvement of the channel of the Mississippi as far north as St. Louis, and this undertaking has now been carried out. One of the most important projects advocated by Captain Eads, however, was the construction of a ship railway across the Isthmus of Tehuantepec. He asserted that this would be cheaper in construction and maintenance and more convenient for commerce than the Panama Canal. In 1884 he resigned his position in connection with the Mississippi Improvement Commission. Mr. Eads became a member of the Institution of Civil Engineers in 1869.

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

(From our own Correspondent.)

WE are rapidly approaching the April quarterly meetings, and trade is slow in responding to ironmasters' efforts to bring about a more vigorous demand in anticipation of those gatherings. The recent declaration of advanced prices has done little to improve makers' position. In some directions it has had a distinctly opposite tendency, by causing orders to be withheld, and it has been taken advantage of by the ironworkers to put forward a claim for higher wages, for which, in reality, there is no valid ground.

Orders at the mills and forges continue of a hand-to-mouth character, and even sheets are hardly so buoyant as a few weeks back, though the tendency to decline is less conspicuous here than in the matter of bars and some other merchant descriptions of iron. To get business, makers, whose order-books are becoming rather bare, are prepared to consent to something rather nearer buyers' terms than heretofore.

On 'Change in Wolverhampton yesterday and in Birmingham to-day (Thursday) it was reported that some bar makers were accepting from 2s. 6d. to 5s. per ton less than the maximum rates of a fortnight ago. Probably, in certain cases, the report is correct, but with the bulk of the firms the market cannot be said to have eased so conspicuously as 5s.

While marked bars remain at £7, and the Earl of Dudley's brand at £7 12s. 6d., second quality bars are £6, and common keep at £5 5s. down to £5. No change can be noted in hoops, which stand at £5 7s. 6d. to £5 10s. for common, and £6 5s. for superior sorts; and nail and hinge strip are unaltered at respectively £5 to £5 5s. for the former, and £6 for the latter.

The steel trade is brisk and prospects are regarded as hopeful. Blooms, billets, and tin bars are being delivered into the district freely from other steel making districts, and there is very little giving way in prices. Steel plating bars are quoted £6 10s., and basic steel of local manufacture is quoted at: plates, £6 10s.; bars £5 10s.; sheets, singles, £7 10s.; and channel and other engineering sections, from £6 upwards. Soft steel boiler plates are quoted by other local firms at £7 to £8 per ton; soft steel blooms and billets, £5 15s. to £6; and heavy steel sheets, singles, £9 to £10.

The demand for ordinary sheets is not over brisk at the moment, and business is doing on the basis of £6 7s. 6d. to £6 10s. for sheets of 24 gauge. Sheets of the Woodford brand are named as £7 for singles, £8 10s. for doubles, and £10 for lattens. Crown Woodford qualities are £9 10s., £11, and £12 10s. respectively. Double best are £12 10s., £14, and £15 10s., according to gauge; while for treble best an additional £2 per ton is quoted for the respective gauges. Mild steel sheets are £13 for 20 gauge, £14 10s. for 24 gauge, and £16 for 26 gauge; while charcoal sheets are £16 for 20 gauge, £17 10s. for 24 gauge, and £19 for 26 gauge.

No alteration has taken place in the value of galvanised iron during the past month, but the demand keeps brisk, and the latest news of the state of the Australian markets is of an improved sort.

The plate mills are very quietly engaged. The increased use of steel instead of iron boiler plates explains the shortness of work in two or three instances, and it seems clear that if old customers are to be retained a new departure at the local plate mills will be necessary.

Native pigs are changing hands only in limited quantities, and the make now appears to be slightly in excess of the demand. Two large makers of common pig iron at Tipton and Bilston keep up their full rate of production, and they are reported to have good orders in reserve. Prices range from 37s. 6d. for all-mine forge to 31s. 3d. for common.

Northampton pigs are now 38s. 6d. to 39s. 6d. per ton, and Derbyshire about 40s., with superior qualities 42s. 6d. Lincolnshire are 41s. to 42s.; hematites, with the exception of the Barrow Company's and another or so special brands, are to be had again this week at 2s. 6d. per ton under the late maximum, making the selling price 57s. 6d.

An estimate of the ungotten coal in the Tipton mines drainage district shows that 55,000,000 tons of the best coal is still available, which, if worked in fifty years at the present low price, will realise an annual income of £300,000.

Constructive engineers hereabouts do not at the present time complain so much of the extent of work offering as of the small profits which can be realised, consequent upon excessive competition. There was never a time when contracts were so much cut up as now, and when so small a difference between competing firms decided the destination of a contract, irrespective almost of the important question of reputation. Inquiries are upon the market for roofs and gasometer work, but the bridge work is not so plentiful. Most of the large firms in the district are keeping their yards steadily employed, but nearly all of them would be glad to see more orders on the books for forward execution.

Messrs. Morewood and Co., Birmingham, report that their roofing yard is now full of work, both for the home and the export trades, and that prospects are fairly favourable.

Messrs. Rubery Brothers, St. George's Works, James Bridge, have just completed the roofs for the new depôt, at King's Hill extension of the Central Tramway Company, Birmingham. Messrs. E. C. and J. Keay, constructive engineers, Birmingham, have taken to the bridge and roofing works at James Bridge, formerly in the occupation of Messrs. Carter, Ford, and Co., and are now executing contracts at the new works.

Some further inquiries are on the market from the Indian railway companies, the most important being for Bessemer steel rails and other work for the East Indian lines, and for steel and iron-work for bridges of 150ft. and 160ft. spans, together with galvanised sheets, cast iron pipes, &c., for the Indian Midland lines.

A large order for cast iron pipes will shortly be given out on account of the Lichfield Waterworks, and hopes are entertained that it may find its way into this district.

The demand for railway fastenings and for engineers' and coach and carriage nuts and bolts does not show much movement, and among the Darlaston makers, which is the great centre of the trade, there is much complaining of the scarcity of work. At James Bridge, however, Messrs. Simpson and Wood and one or two other firms have lately received some good repeat contracts from certain of our home railway lines for nuts, bolts, and spikes, and also some entirely new contracts, likewise for home railways.

The patent process for making solid-drawn copper tubes, introduced by Messrs. Ralph Heaton and Sons, the Mint, Birmingham, and which has been fully noticed by THE ENGINEER, has proved a pronounced success, and the firm are putting down more machinery to execute the orders, which are being received much faster than they can execute them. As an evidence of the manner in which the invention is appreciated on the Continent, the patent rights have been already sold for several States, and negotiations are going on with other countries for securing the right of working the patent. Numerous manufacturers have been over to Messrs. Heaton's establishment to see the process in operation, and, without exception, have expressed their surprise at the marvellous results so simply obtained. It would appear that a revolution in the mode of producing those seamless tubes has really been effected.

Sixteen large copper tubes, forming part of the metal trades' triumphal arch about to be erected in Birmingham on the occasion of the Queen's visit, have been produced in this way, and will weigh over 1½ tons. Eight of the tubes are over 20ft. long, and are 5in. in diameter, and the others are 12ft. long. In the erection of the arch—which is to cost close upon £1000—more than 200 large metal tubes of brass, copper, or iron will be employed in all, together with rods or plates of metal, and if the day be sunny the effect will be brilliant. The foundations are of bronzed iron.

Competition in the ships' metal sheathing and copper tube trades continues severe, and the testimony this week of the chairman of Muntz's Metal Company, Birmingham, is that there is not much probability of this competition at present becoming much less, though a little arrangement which the company have lately entered into may take off the sharp edge. The process of manufacturing seamless copper tubes in operation at these works, under the invention of Mr. T. Budworth Sharp, the general manager, is, in the opinion of the directors, very valuable. It enables them to produce a better tube at a lower price, and so to obtain orders which otherwise would not be received. But the economy of the process does not make up for the severe general competition.

Messrs. G. Kynoch and Co., the well-known ammunition makers, of Birmingham, have just secured a Government contract for the supply of 1¼ millions of cartridges for the Martini rifles; also for a million solid drawn cases for cartridges of the same description. The rejection by the Government of certain cartridges supplied last year is attributed by the directors to an unfair test, the cartridges having been made for rifles, but having been put into a machine gun and fired at the rate of some hundreds a minute.

The New British Iron Company obtained damages at the Birmingham Assizes, amounting to 100 guineas, from a firm of iron goods manufacturers, for fraudulently marking goods with the company's well-known "B.B. Lion" brand. A Basingstoke firm of boiler makers was last year supplied by the defendants with pan-headed rivets stamped with the New British Company's brand, but which ultimately proved to be made of inferior iron falsely marked.

An improved automatic stop block for use in mines, and which was described before the North Staffordshire Mining Institute on Monday, has been invented by Mr. W. Scott, the especial features of which is its perfect reliability and its economical use. The block, which can be made of steel, iron, or wood, is fitted at each lift to stop the cage at the proper place for caging the load on either side of the dip. The cage and balance can also be fitted with an improved drag and catch-hook, to prevent destruction to plant in case the rope should break.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—Except that one comes across a good many people who talk in a more cheerful tone, and which may be taken as an indication that there is a better feeling on the market, it can scarcely be said that there is any actual improvement in the general condition of trade. There is perhaps rather more inquiry stirring amongst users of iron, with the prospect of an increased weight of work coming forward in the future, and in some cases rather more work has recently been got, but the present actual state of trade continues most unsatisfactory. For present requirements very little iron is wanted, and where business is done it is mostly at prices that do not pay, so far, at least, as the producer is concerned; for forward delivery there are buyers in the market, but, as a rule, they offer prices that makers do not care to entertain, and the result is that actual operations are restricted to the most limited dimensions.

The atendance on the Manchester Iron Exchange on Tuesday was about an average one, but the market was extremely dull, and it was only in very exceptional cases that transactions of any weight were reported. For Lancashire pig iron the average price was about 39s. to 40s., less 2½, for forge and foundry qualities, delivered equal to Manchester, but makers were open to offers where there was actual business to be done; the same may be said with regard to district brands, which in one or two cases are also quoted at 39s. to 40s., less 2½, delivered here, but there are makers of Lincolnshire iron who would readily accept 1s. to 1s. 6d. per ton under these figures to secure orders. In outside brands offering here there is keen competitions with Scotch iron, some brands being offered at 1s. to 1s. 6d. per ton under makers' quoted prices, and in Middlesbrough iron g.m.b. foundry can be got at 43s. 4d., with special named brands quoted at 44s. to 44s. 4d. net cash delivered equal to Manchester.

Although makers of hematites do not give way to any appreciable extent, prices in the open market are easier, and good No. 3 foundry qualities can be bought without difficulty at about 57s. to 57s. 6d., less 2½, delivered into this district.

In manufactured iron trade generally continues very dull. In exceptional cases makers have sufficient work to keep their forges fully employed, but the finished ironworks generally throughout this district are only kept going very indifferently. Where makers are not absolutely in want of orders they hold out for £5 2s. 6d. as their quoted price for bars delivered into the Manchester district, but for prompt specifications to keep works going £5 per ton is accepted readily; hoops average £5 5s. to £5 7s. 6d. and sheets £6 10s. to £7 per ton delivered into the Manchester district.

Amongst engineers there seem to be a few more inquiries stirring, and here and there some firms are better supplied with work, to secure which prices have had to be cut excessively low. It can scarcely be said, however, that there is as yet any greatly increased weight of orders coming forward, and engineering and machine shops are still generally short of work. The reports for the past month issued by the various trades union societies connected with the engineering branches of industry are again more hopeful in tone as to the prospects of trade, and show a continued decrease in the number of members on the books in receipt of out-of-work support. The returns of the Amalgamated Society of Engineers show a considerable decrease in the unemployed members in the Manchester district, there being now 25 per cent. less on the books than was the case a couple of months back; but this is largely accounted for by the fact that at the commencement of the year there was a considerable number of men who had been stopped for the holidays, and had not been taken on again. Apart from this, however, the returns show an unquestionably better demand for labour, although it cannot be said that it is as yet of any very marked character generally, the number of unemployed on the books throughout the branches of the society being still about 7½ per cent. of the total membership, which is only a decrease of about ½ per cent. since the commencement of the year. The report of the Steam-engine Makers' Society indicates a fairly improved tone as to the amount of new work coming forward, and the inquiry for men is rather better; judging, however, from the number of men who are actually wanted, it can scarcely be said that the condition of trade generally really shows any very marked improvement, and the number of unemployed on the books of the society remains practically the same as last month, averaging about 4 per cent. of the total membership in receipt of out-of-work donation. The report of the Boilermakers' Society shows a considerable decrease in the number of unemployed on the books, there being about 300 less than last month in receipt of out-of-work support; whilst there is a large increase in the number of new members admitted during the month. The Moulders' Society also reports a decrease in the number of unemployed. The returns received through the various societies from the shipbuilding centres are decidedly better; locomotive builders and tool makers are also reported to have received fair orders in some cases, and from some important industrial centres the returns are beginning to report trade as good; but generally the condition of the trade is still only returned as moderate.

An interesting paper on "The Conservation of Energy" was read by Mr. S. Dixon—Messrs. Kendal and Gent, Manchester—before the members of the Manchester Association of Engineers at their meeting on Saturday. Mr. Dixon in his paper traced the stream of energy developed in the first place from coal on to its work, pointed out how this stream of energy was wastefully dissipated at various points, and gave a comparative estimate of the responsibility which rested upon boiler makers, steam and gas engine makers millwrights, and engineers, as workers in metals, for this dissipation of energy. The total result was the humiliating fact that out of the whole stream energy which they had brought into existence from the coal, they as engineers were only able to utilise about one-tenth. What seemed to be wanting in all their engineering work was that they should bring greater scientific knowledge to bear on their work, and with it a more truly scientific habit of mind which estimated and measured everything, and took nothing for granted, however plausible it might seem to be. In the erection of gearings, &c., and the thorough testing of the efficiency of machinery, they really wanted a far greater use of the dynamometer, so that accurate returns might be made and tabulated, which would very quickly settle many of the disputes as to the best methods of driving, and carry the question out of the reach of opinion into the clear region of scientific fact about which there could be no dispute. In the course of his paper Mr. Dixon referred to the results which have been set forth as attainable by means of electricity as a medium for the transmission of power, and also drew attention to the rapid rate at which our supplies of coal were being exhausted. In the discussion which followed the president, Mr. Ald. W. H. Bailey, cast considerable doubt upon the statements which were put forward as to the electrical transmission of power, and stated plainly that he did not believe all that was asserted on this point, and questioned very much the possibilities of its being worked in an economical manner except under special conditions. As to the question of the exhaustion of our coal supplies, he did not think that we should, after all, suffer very much injury if our coal supplies were used up. It was mainly a question of carriage, and when we deducted all the cost of getting, it did not really represent a very important advantage we possessed. At the same meeting of the society seventeen new members were elected—one life honorary, eight honorary, and eight ordinary members.

As a further step towards carrying out the Manchester Ship Canal project to a successful issue, private circulars have been sent out in the district setting forth the policy which the board of directors intend to pursue, and to which they will invite support. In my "Notes" next week I may possibly be able to furnish some particulars as to the result of this appeal.

A limited company, under the title of Hampton's "Special" Ingot Steel Company, has been formed for the purpose of establishing a new steel works at Manchester. It is proposed to purchase a complete Bessemer steel plant now standing on the premises of the Manchester, Sheffield, and Lincolnshire Railway Company, which, when in full working order, is stated to be capable of producing 600 to 800 tons of steel ingots per week, and to either rent or purchase premises adjoining and in connection with the works of the Ashbury Railway Carriage and Iron Company, which consists of the whole of the tire mills, boilers, four steam hammers, engines, furnaces, &c., with the buildings and sheds. The company has the option of purchasing the right to a patent belonging to Mr. Thos. Hampton and Mr. John Facer, for the manufacture of special steel ingots by an improved method, which consists in casting parallel ingots in groups in divided moulds, in sizes varying from 3in. square and upwards, similar to the moulds used in casting crucible steel ingots, and by which method it is stated the ordinary process of cogging and billeting is avoided. Mr. Thos. Hampton is to act as managing director and general manager of the proposed new company for a period of five years.

In the coal trade there is steady business still being done generally. The recent cold weather has helped up the demand for house fire coals, and there is still a fairly active business doing in the common coals for shipment, which compensate for the restricted local demand for steam and iron-making purposes. Engine classes of fuel move off moderately well. Pits generally are working pretty near full time, and although there is some underselling, quoted rates remain without change. At the pit mouth best coal averages 9s.; seconds, 7s. 6d.; common house coal, 6s.; steam and forge coals, 5s. 6d.; burgy, 4s. 6d. to 5s.; best slack, 3s. 6d. to 4s.; and common, 2s. 6d. to 3s. per ton, with steam coal for shipment ranging from 7s. to 7s. 6d. per ton, delivered at the high-level, Liverpool, or the Garston Docks.

The proposed restriction of the output by the miners in the south-west Lancashire district seems to have fallen through as anything like a combined movement, and the whole matter is treated with indifference by the colliery proprietors.

On Friday last, 11th inst., Messrs. J. F. Waddington and Co. successfully launched from their shipyard at Seacombe a steel cargo barge, 55ft. long, constructed to carry fifty tons dead weight. The barge is for river traffic abroad.

Barrow.—There is a firm and steady tone in the iron trade of this district, although, as a matter of fact, speculators are still underselling the market. It is also evident that other districts are somewhat below the west coast in quotation for hematite pig iron. Buisness has been done at Glasgow and elsewhere from 45s. 9d. to 47s. per ton net at twenty days, but in this district mixed parcels of Bessemer iron are quoted at 50s. per ton net f.o.b., and 49s. for No. 3 forge and foundry iron. These prices have been now maintained for more than a month. It is evident that the cause of this position is to be found in the fact that makers hold large orders for hematite and are working on them without booking many new orders, in the hope and belief that prices will soon advance. The fact that when the market showed signs of considerable and permanent improvement in September and October last, speculators rushed in and bought large parcels, while a satisfactory position at the time was helping up prices for legitimate trade must be accepted as the cause of the present depressing tone in the market. Holders of iron are in fact at present in possession of the market, and although makers are hopeful that they will be able to secure better prices shortly, it remains to be seen to what extent the action of holders of iron are likely to influence prices. Makers are, however, sold forward, generally speaking, till July, so that for the moment they are not feeling the effects of the fall in prices. Stocks are largely held. Very good inquiries are to hand from America and the colonies, and there are still undoubted evidences of a brisk season in reference to the foreign trade in hematite pig iron. The steel trade remains in an exceptionally active state, and orders are freely offering for rails, blooms, and billets; in fact, more orders are in the market than makers can cope with. This is owing not only to the large demand which has arisen on American and colonial account, but from home sources. Several good home orders have been booked during the past few weeks for forward delivery. There is a good prospect of the continuance of good trade in rails and blooms, although there is no doubt that America will lead the van in this demand, and at the same time supply herself largely with the heavy steel goods which are so largely on order here. The shipbuilding trade remains very quiet in tone, and no new orders have been received. Iron ore is in unsteady demand at from 12s. to 13s. 6d. per ton, but raisers are not pressing sales, and they are not disposed to sell in any bulk until they see what is the ultimate effect of the present activity in trade generally. Engineers are not busy either on marine or general account. Mr. J. T. Smith, who recently retired from the general management of the Barrow Hematite Steel Company, is about to leave Croslands, Furness Abbey, in April, and take up his residence at Rhine Hill, Stratford-on-Avon. He still remains a director of the Barrow Steel Company. The Duke of Devonshire, through failing health and advanced years, has retired from the chairmanship of the Barrow Hematite Steel Company and the Barrow Shipbuilding Company, and the Marquis of Hartington succeeds him in these two important posts. His grace was the first president of the Iron and Steel Institute, and has always taken a deep interest in the iron and steel industries. It is hoped that the active and direct interest taken by the Marquis of Hartington in the trade of Barrow and the Furness district may lead to satisfactory results, and that the Duke of Devonshire, now that he has handed over to his son the arduous cares of a business life, may long be spared to take even a silent interest in the great industries his enterprise and capital have been mainly instrumental in bringing into life in Furness.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The principal event of the week has been the announcement that Messrs. Vickers, Sons, and Co., River Don Works, Sheffield, contemplate doubling their capital. The report is confirmed by a circular issued to the shareholders.

The Brightside Steel Works—Messrs. Wm. Jessop and Sons—report that every branch of business in which the company is engaged continued in a depressed state during the greater part of the year, but in the closing months there was an increased demand for the company's manufactures, and the hope is entertained that this improvement will be maintained throughout the year.

Messrs. Newton, Chambers, and Co., have just completed the making of a very large cast iron tank and wrought iron gasholder for the Hastings gasworks, with the fittings and connections. The firm are also engaged upon another large five tier cast iron tank and wrought iron gasholder, 100ft. diameter, for La Plata, South America. There is a good demand for gas work at present from various parts of the country, and the Thorncliffe Company have a large share of the work.

A memorial pulpit has been erected in the Sheffield Parish Church to the late Mr. George Wilson, J.P., of Banner Cross, chairman of Charles Cammell and Co., Cyclops Steel and Iron-works. Mr. Wilson was one of the most remarkable men who ever crossed the border. He came to Sheffield some thirty years ago, and became closely identified with its great steel and iron industries. His extraordinary business capacity, coupled with a genius for organisation and for the management of men, soon brought him to the front, and in a few years he was the keystone of an establishment which is known the world over, ultimately becoming chairman and managing director. His great ability developed and extended the business until the company employed 10,000 workpeople, by whom he was regarded with feelings of loyal regard. He did much to make Sheffield what it is, and when he was suddenly struck down in the midst of his activities in November, 1885, the whole community mourned his loss. The Archbishop of York inaugurated the "George Wilson" memorial pulpit—a magnificent example of the wood carver's art—which was erected and presented by his widow, who is further placing a memorial font in the Ecclesall Church, of which deceased was churchwarden. Mr. Wilson, in addition to the many incidents which made up a brilliant business career, will be remembered as the first who conceived and carried out the bold policy of transferring the steel rail trade from the interior to the coast. His policy, which was much controverted at the time, has proved successful. At Workington, in Cumberland, Messrs. Cammell and Co. carry on a great export trade in rails, which would have been impossible, owing to railway rates for the raw material and finished goods, if the manufacture had been kept inland.

It is commonly supposed that the Sheffield grinder never reaches a mature age. A pleasant exception is Samuel Crawshaw, who was entertained at dinner, on attaining his 70th birthday, last Monday evening. Mr. Crawshaw was apprenticed as a pen-blade grinder at Messrs. Joseph Rodgers and Sons fifty-six years ago, and is still regularly employed by the firm. His father was the first grinder who worked at his trade after having attained his 60th birthday. Mr. Crawshaw began at the Old Park Wheel, and moved with his father and a well-known Sheffield grinder named Whittington to the first steam wheel ever started in the town.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

There was a good attendance at the Cleveland iron market held at Middlesbrough on Tuesday last, but business was almost at a standstill, as neither buyers nor sellers seemed anxious to operate. For prompt delivery merchants asked 35s. 3d. per ton for No. 3 g.m.b., but small lots changed hands at 35s. 1½d., and even at 35s. Sales, however, at any figure were few and far between. Consumers are well covered for immediate delivery, and producers think they will realise better prices by waiting for two or three weeks, when the navigation season will commence. For delivery to the end of June 35s. 9d. to 36s. per ton is offered, but sellers show no inclination to accept. Makers are virtually out of the market. Few will quote at all, and the remainder still talk of 39s. for No. 3. Forge iron is quoted at 33s. 9d. to 34s. per ton.

Messrs. Stevenson, Jaques and Co.'s current quotations:—"Acklam Hematite," Mixed Nos., 50s. per ton; "Acklam Yorkshire"—Cleveland—No. 3, 39s. per ton; "Acklam Basic," 40s. per ton; refined iron, 54s. to 64s. per ton.

The demand for warrants is by no means active, either at Middlesbrough or Glasgow. The current price is 35s. 1½d. per ton.

The stock of Cleveland pig iron in Messrs. Connal and Co.'s Middlesbrough store was, on the 14th inst., 312,690 tons, being an increase of 256 tons for the week.

An improvement has taken place in the shipments of pig iron from Middlesbrough. The total quantity sent away from the 1st to the 14th of March inclusive was 28,875 tons, against 24,537 tons in February, and 10,109 tons in January, corresponding periods being taken.

Finished iron makers are still experiencing no improvement. The Stockton works are fairly well supplied with orders, but specifications are difficult to obtain, and no advance in price can be secured. Common bars and ship plates are offered at £4 15s. per ton, and angles at £4 12s. 6d.—all free on trucks at makers' works, less 2½ per cent. discount. Puddled bars are quoted at £3 2s. 6d. per ton net.

The miners who are thrown out of work by the stoppage of the Boosbeck mine have done something practical in the way of getting royalty owners to reduce their royalties. The men sent a deputation, headed by Mr. Joseph Toyn, to wait on some of them. They were so far successful that they induced Mr. J. T. Wharton, of Skelton Castle, one of the largest and richest royalty owners in the district, to intimate that he would consider a reduction in royalty of 2d. per ton, if that would be a sufficient relief. The men are following the matter up with the lessees and with other royalty owners. They think that if all would do the same as Mr. Wharton it would pay to re-start the mines.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

There has been a fair business in the Glasgow warrant market this week, with frequent fluctuations in the quotations. But the tendency of prices has, on the whole, been slightly downward. The past week's shipments were larger than usual, being 10,690 tons, against 6009 in the same week of last year. The inquiry is at present limited, however, and as the stocks are increasing, and the output of pig iron is likely to be maintained, if not increased, there has been little or no encouragement to speculative buying. The result has been a rather depressing state of the market, out of which it is not easy to see how it can immediately be brought. Our principal customers for Scotch pigs at present are the United States and Italy, to which countries much more iron is being sent than at this time last year. But the continent is easier satisfied, and the home requirements are also below the average. We are likewise importing less iron from Cleveland, and scarcely any at all from Cumberland. The Spanish ore import trade is, however, brisk. Probably the larger proportion of the current imports of this ore are made up of purchases that were made several months ago, yet merchants reported this week that there were good inquiries in the market. Prices of campanil ore delivered on the Clyde are 13s. 4½d. to 13s. 6d. per ton, and rubio ore about 3d per ton less. Ore freights from Bilbao are down to 6s., being 3d. to 6d. less than they were a week or two ago.

Business was done in the warrant markets on Monday at 43s. 7½d. to 43s. 9d., and back to 43s. 4½d. cash. On Tuesday the cash prices varied from 43s. 5d. to 43s. 2d. cash. On Wednesday business took place at 43s. 1½d. to 43s. 3d., and back to 43s. 2d. To-day—Thursday—transactions occurred at 43s. 1d. to 43s. 2½d., closing with buyers at 43s. 1½d. cash.

Cleveland and Cumberland warrants have this week been somewhat lower on 'Change in Glasgow.

The current values of makers' pigs are:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 50s. 6d.; No. 3, 44s. 6d.; Coltness, 56s. 6d. and 46s.; Langloan, 52s. and 46s. 6d.; Summerlee, 54s. and 44s. 6d.; Calder, 52s. and 43s.; Carnbroe, 47s. and 42s.; Clyde, 48s. and 43s.; Monkland, 45s. and 41s. 6d.; Govan, at Broomielaw, 45s. and 41s. 6d.; Shotts, at Leith, 50s. and 45s.; Carron, at Grangemouth, 52s. 6d. and 44s. 6d.; Glengarnock, at Ardrossan, 49s. and 43s.; Eglinton, 44s. 9d. and 41s.; Dalmellington, 46s. 6d. and 42s. 6d.

One or two fair orders have been received in this district for bridge work and railway sleepers, but some of the general engineering firms are still much in want of employment. The steel works are nearly all very fully employed, and there are additional orders for shipbuilding expected to be placed without much delay.

In the course of the past week there was shipped from Glasgow a screw steamer of small size, and a barge, for Calcutta, valued at £4800; machinery, £2000 worth; sewing machines, £5070; steel goods, £5200; and general iron manufactures, £20,050.

Several fresh shipbuilding contracts have been placed with Clyde builders, including an Allan line steamship of large dimensions, to be fitted both for cargo and passengers, with Messrs. D. and W. Henderson, and a patent hopper dredger of 1000 tons for the Bombay Harbour Commissioners, with Messrs. W. Simons and Co., of Renfrew.

There has been a very considerable improvement in the shipping department of the coal trade.

It is by no means certain that there will not be additional trouble with the miners. The adjourned conference of masters' and workmen's delegates for Lanarkshire, which took place in Glasgow at the close of last week, broke up without having come to any agreement. While the masters were submitting conditions of labour and insisting upon pits being kept going six days, instead of five, a week, the delegates of the men abruptly withdrew, stating that they could not even discuss such proposals. On Monday the Associated coalmasters, who embrace fully 90 per cent. of the output of the district, posted the following notice at their collieries on Saturday:—"It is hereby intimated that colliers' wages at this colliery will be advanced 6d. per day, from and after Monday first, on condition that the pits be worked as heretofore, six days a week." The coalmasters of Airdrie, Slamannan, and Bathgate, have offered to give the advance of 6d. per day if the men agree to work eleven days a fortnight.

At the annual meeting of the Mining Institute of Scotland, held in Glasgow—Mr. Jas. S. Dixon presiding—Mr. Henry Aitken was appointed vice-president, and Messrs. F. G. Rowan, C.E., John Gemmill, M.E., and H. Mungall, coalmaster, were elected members of the council. The chairman reported that he had taken part in the conference with the Home Secretary on the Mines' Bill, and he was glad to say that the Bill had been very much modified, and that many of the suggestions of the committee of the Institute had been adopted.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

The ordinary quarterly meeting of the Miners' Provident Society was held on Saturday last in Cardiff, Sir W. T. Lewis presiding, and as this society is now becoming a power in the land some details will be of interest. During the last quarter there was an increase of members to the extent of 1864. This shows that the colliers are now finding it a great support. The amount of relief paid in various ways gives an insight into the disasters that take place and which are only to be expected in the employment of 50,000 men and the output of 13,000,000 tons of coal annually. During the quarter the society paid £4640 to disabled members alone, then £250 on the death of members, £672 to widows, and £685 to children. Previous to the existence of this society all the support had was from the parish and voluntary aid. Query, should not ratepayers aid the society? I note that landowners are coming forward very freely, and Mr. Crawshay Bailey, by his annual subscription of £100, has followed the good example of the Marquis of Bute.

The industries of Wales are more satisfactory. Coal is in much better demand, and while the exports are well maintained at all the ports, there is a decided movement towards an advance. I expect that this week has witnessed several advances as "prompt deliveries," for owing to the weather many pits have been seriously affected, and the snowdrifts have told on the output.

The Cardiff foreign coal output last week was nearly 163,000 tons, and a good deal of activity has been shown at docks and on rail. At the Bute Dock the Marquis has opened the extension, which adds much greater facility. The docks could now grapple successfully with a large northern coal contingent from the Monmouthshire valleys if the fates had willed it. The Cardiff and Monmouthshire Bill is to come on again.

I hear that during last year half a million tons of coal from the Rhondda Valley passed over Sir George Elliott's new line.

Newport, Mon., at a late visit gave me pleasing indications of improvement. Nettlefold's new industry will do great things. The tin-plate works which formed a substantial background to Newport are re-starting one after the other, and the new lines forming, activity at docks, &c., show a formidable rivalry to Cardiff, especially as Monmouthshire coal is improving in estimation, and is cheaper. The extension of the electric telegraph to mines is progressing. A few weeks ago a successful experiment was carried out in the Rhondda. This week some of the collieries of the Plymouth Mortgage Company will be fitted with it. Mr. Hankey has spared no expense of late in the improvement, and in developing the capacity of his collieries, showing that though in work—the principal since 1804—there is a good acreage left.

The success of the new colliery near Pontypridd, the last of the deep sinkings, is assured. Neither the 3ft. nor the 2ft. 9in. turned out well, but the 4ft. has been represented to me as magnificent, the seam really being 6ft. 2in.

The iron industry, though not so active as that of coal, has some better signs, and though cargoes for foreign and colonial destinations are still limited, yet the mills are busier, and more rails are being made. Improvements, too, are going on. I note at Blaina that another patent blast furnace is in erection, and protection for the men from the weather has been carried out.

The Pontypool tin-plate works are now going again, and the confederacy, which has cost £1000 of the tin-plate workers' money, of Glamorgan, is coming to an end.

The trade is not quite so brisk as one would wish to see, though Swansea consignments keep up. Coke sheet wasters are from 12s. 3d. to 12s. 6d.; ordinary cokes fetch 13s. to 13s. 6d.; Bessemers about 13s. 3d.; Siemens from 13s. 6d. to 14s.; charcoals from 14s. to 15s. 9d. The lowest price touched for cokes in the past has been 12s.; the highest, 32s. There is some anxiety felt at Swansea about the future, and it is expected that when the Monmouthshire works are in full drive again the difficulty with buyers will be increased. American agents are even now beginning to hold back.

The Castle Works, which Messrs. Nettlefolds are erecting for the manufacture of the highest class of special mild steel, &c., are now in a forward state, and a short description of them may be of interest to your readers. They are approached by a siding from the Great-Western Railway Company's Western Valley's line, which is carried over the high road to Newport by means of a handsome viaduct which is continued for some distance at a high level above the site of the works, and consists of nine arches in all. By the side of this viaduct is the staging which carries the cupolas and converters, next to which is the engine-house, containing the blowing engines. On the other side of this engine-house there is a siding for coal trucks, from which the coal will be unloaded into a series of bunkers with sliding doors at the bottom, from which it will fall into small wagons and be taken in these directly over the charging hoppers of a series of nine blocks of Siemens' newest type of gas producers. In front of these producers, and fed by a portion of them, is the range of boilers, the remainder of the gas being taken in flues round the works to the various heating furnaces. The pig iron will be unloaded on the top of the cupola staging, and when melted will fall from the cupolas into the converters, and thence through the ladles into the ingot moulds at the bottom of the casting pit. Immediately opposite the casting pit are the furnaces for re-heating the ingots, which then pass to the cogging mill, which is specially arranged for the economical production of billets and other small sections in long lengths. The billets and bars will be taken from the cogging rolls and cut up under the shears by means of live rollers. From the shears they pass to the finishing mills, of which there are four, all designed for rolling wire of various sizes, bars, rods, hoops, and the various special sections for which Messrs. Nettlefolds are celebrated. The works are designed with a view to taking advantage of the natural features of the site. All the materials used will come in at the high level, and pass downwards and forwards until the finished article is loaded into trucks. There will be no unnecessary lifting or moving. The necessary smiths' and fitting shops complete the works. The offices are on the opposite side of the road, and comprise ample accommodation. A little higher up the valley, on the site of the old Tydu Tin-plate Works, Messrs. Nettlefolds have erected a commodious building, in which they are making for the H.P. Horse Nail Company, of London, their celebrated H.P. brand of horse nails. This company was forced by an adverse decision in an action brought against them by some owners of adjacent property, and also by the very large and continually increasing demand for their nails, to abandon their old premises at Battersea, in London, and they then made arrangements with Messrs. Nettlefolds to undertake the manufacture of these nails at their new works. For this purpose only the very finest brands of Swedish iron are used; the bars are rolled to the proper sections at the lower works, and are sent to the upper ones to be cut into nails by the H.P. Company's patent machinery.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

The Rhenish-Westphalian iron market is still labouring under the influence of the threatening political clouds, though the peace-promising result of the elections and the Emperor's speech have had a somewhat soothing effect; but still its tone is unsettled, and this checks speculation and enterprise, so that of late only here and there small orders have been given out, whilst the larger ones are being kept back. However, this is of little consequence for the moment, as all kinds of works have plenty of orders to go on with for a considerable time to come. In a few cases business has improved during the week, but this is not sufficient to enable a favourable prognostic for the future to be made. Hopes are now concentrated on the coming spring demand. With few exceptions, prices have been maintained since the beginning of last month, and have in some cases risen. Industrial shares have, on the other hand, become weaker, and show at the Bourse a fall of 1½ to 2½ per cent. The Silesian market was, of course, also affected, but the last reports show returning confidence, and the large iron merchants have raised their prices for wrought iron of all kinds. A boiler plate and sheet iron convention is now about to be formed there, on the same unified principle as that for bar iron, with a common bureau for sale and collection of orders; so the prices of these articles will also shortly be put up. The market in Belgium is quiet and satisfactory, and the ironworks are well supplied with orders for the present, while the machine and constructive iron shops would be glad to see more work come in. Great interest is being shown in some trials with a new system of permanent way, invented by M. Sandberg, by which rails 9 m. long, weighing 50 klos. per metre, are used, and a double duration of life is claimed for the rails by the system, which is a sorry look out for the steel works. The French market seems to have recovered its former tone, as one of their industrial journals says, on account of the result of the German elections. If so, its confidence is in advance of that of this country. In spite of all this the base price of merchant bars can only be quoted at 135 to 140f. p.t.

Ores in the Rhine-Westphalian districts have been obliged to succumb to the pressure of circumstances, and prices have not been able to maintain their former height, though the fall is only about 3d. to 4d. per ton. Spanish, on the contrary, are a little dearer as the export of them has increased. Siegerland stub-stone is now quoted M. 9·00 to 9·20, roasted 12·50, brown iron ore 9·20 to 9·50, and glance 10·00 to 10·50 per ton on trucks at station. Of the pig iron market there is little more to be said than in last report, as nearly all the blast furnaces have sold their make up to the beginning of the third quarter. Under these circumstances there can therefore be little question of prices receding at present, and when sales are effected, in spite of the quiet state of the market, with few exceptions, they are fully maintained. To the exceptions belongs forge pig in the Siegerland, which was put up too rapidly after the improvement set in, and has had to give way a little lately, but which seems now again on the point of recovery, as customers appear to be getting a little more confidence in the situation, and are inclined again to purchase. Spiegeleisen keeps up its price, as so much goes abroad; forge, Bessemer, and basic, are well called for. The first is noted M. 53 to 59; the second, 49 to 56; the third, 49 to 52; the fourth, 42 to 43; and Luxemburg forge, 33·60 to 34 p.t. Very few new orders are now coming to the rolling mills and forges, but still they are fully employed night and day on bars, great quantities of girders, angles, hoops, and wire rods. The merchants wish first to dispose of the stocks they laid in at cheaper rates in November, December, and January before entering into new engagements at enhanced prices. On the 8th inst. a convention of the principal Rhine-Westphalian rolling mills was definitely agreed to, and a uniform selling price of bar iron of all sorts adopted, which it is hoped will ultimately embrace all the other rolling mills of the country. Boiler and other plates are in better request, and M. 145 and above is easily obtained for them, and the thin sheet works are still as well employed as ever, and prices keep firm. The wire rod business is in all respects a satisfactory one, and there is little new to relate, except that again exceptionally large quantities have lately been shipped to America, and that prices, demand, and deliveries have not slackened. The export price is M. 105 to 110, and the inland one 115 p.t. Orders for steel railway material have come to the works in sufficient volume to keep this branch busy for a time, but the American demand for wire billets has lately shrunk considerably. The following are the base prices per ton on trucks at works:—Good merchant bars, M. 100 to 110, sometimes higher; angles 110 to 113, and higher; girders, 98 to 100, and higher; hoops, 108 to 115; iron and steel billets, 112 to 125, and 130 in isolated cases; best boiler plates, 145 to 148; common, do., 135 to 140; thin sheets, 135 to 140, and for certain brands 2 to 5 higher; heavy plates in iron and steel, 140 up to 160, some works asking 165; drawn wire, 130; steel rails, 122 to 130; sleepers, 120 to 125; wheels and axles, fitted, 300 to 320; axles, 235 to 240; tires, 215 to 220. The machine, boiler, and constructive iron shops, foundries, and wagon works, are, as a rule, not sufficiently supplied with orders, though here and there some can boast of an influx of work; but the everlasting complaint is of unremunerative prices. Spelter costs 290 to 300 marks the ton.

The sale of coke is good, especially for neighbouring countries in the West, and the prices for both coal and coke are firm, the latter rising.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, March 3rd.

TO-DAY'S quotations for foundry iron are 22 dols. to 23 dols. for No. 1 and 21 dols. for best No. 2. The mill owners are buying very little forge iron, and will not cover the requirements for the second quarter of the year until about the close of the month. Meanwhile, they will be able to determine the probable course of prices. A good many anticipate a slight reaction, though the grounds for this belief are not well taken. The furnace output is about 20,000 tons per day; but despite this heavy production, stocks are almost unknown excepting in consumers' hands, and they are not heavy. All of the finer brands of foundry and forge iron in both Eastern and Western markets are now contracted for from two to four months. Some of them are practically sold up for the entire season. Prices for the second quarter's supply will be fixed on the 1st of each month. Large lots of English Bessemer pig have been contracted for this week. The sales will foot up 30,000 tons. Brokers have been unable to close for large lots of steel rail blooms and billets, but a good deal of business has been done that has not reached the newspapers. Western Pennsylvania buyers are now about closing contracts for steel in billets, blooms, and slabs. A company is about establishing a line of ships to transport manganese ore from Cuba to Philadelphia or Baltimore. The Lake Superior mining companies will have sold a full year's production, and are making their final preparations for active operations as soon as the weather permits. The railroad bridge builders will place contracts during the next four weeks for about 20,000 tons of material, according to estimates given. Beams and channels are quoted at 3·30, which is about the selling price. Angles, 2·30. Plate iron is in very active demand at 2½. Merchant bar iron will probably advance 2 dols. per net ton. American furnaces are declining to book orders excepting at full prices. Bessemer is 18 dols. to 19 dols. for American. Steel rails are quoted at 40 dols. to 41 dols. The mills are almost bare of stocks in old rails and cargo scrap. Very little is being done outside of the daily current demand in tin and tin-plate. Stocks are sufficient and prices are firm. The tin-plate consumption will probably exceed last year's by from 5 to 7 per cent.

NEW COMPANIES.

THE following companies have just been registered:—

Brazilian Coal Company, Limited.

In England, Rio de Janeiro, and elsewhere in South America, this company proposes trading as coal and fuel merchants, wharfingers, shipowners, ship chandlers, bankers, and as manufacturers and dealers in ice, distilled water, and salt. It was registered on the 9th inst., with a capital of £50,000, in £100 shares. The subscribers are:—

	Shares.
A. F. Brama, Monte Video, merchant	100
John Cory, Cardiff, merchant	46
R. Cory, Cardiff, merchant	46
S. C. Cory, Cardiff, merchant	2
C. J. Cory, Cardiff, merchant	2
E. R. Moxey, Cardiff, merchant	2
H. B. Cory, Cardiff, merchant	2

The number of directors is not to be less than three, nor more than seven; the subscribers are the first; qualification, two shares. The directors will not be entitled to any special remuneration for their services.

Cwmfynhadog Slate and Slab Quarry Company, Limited.

Registered on the 8th inst., with a capital of £25,000, in £10 shares, to acquire and work mines and quarries in England and Wales. The subscribers are:—

	Shares.
J. Gould Cooper, 63, Church-street, Manchester, merchant	1
A. Simpson, Settle, York, hotel keeper	1
J. S. Jones, Llanberis, quarry manager	1
H. O. H. Uchaf, Llanberis, quarry manager	1
R. H. Brooks, Manchester, cashier	1
J. R. Speakman, Cheetham, Manchester, bookkeeper	1
J. B. Brockbank, Clayton, Manchester, salesman	1

The number of directors is not to be less than two, nor more than four; qualification, 10 shares. Most of the articles of Table A apply.

Hampton's "Special" Ingot Steel Company, Limited.

This company proposes to manufacture "Special" steel ingots, and for such purpose will purchase the Bessemer plant belonging to Thomas Hampton, of Barrow-in-Furness, recently acquired from the Manchester, Sheffield, and Lincolnshire Railway Company; and also a plot of land at Openshaw, near Manchester, adjoining the works of the Ashbury Railway Carriage and Iron Company, Limited, with the Tyre Mill and other buildings erected thereon. It was registered on the 2nd inst., with a capital of £50,000, in £20 shares. The subscribers are:—

	Shares.
*S. C. Thompson, J.P., 47, Higher Ardwick, Manchester, brewer	1
*Clegg Livesey, Bosden, near Stockport, colliery proprietor	1
*Robert Phillips, Higher Broughton, managing director to the Ashbury Railway Carriage and Iron Company	1
J. Halliday, Cheetham, engineer	1
T. Hampton, Barrow-in-Furness, steel manufacturer	1
E. Morris, Bradford, Manchester, clerk	1
W. Jaffrey, Withington, near Manchester, plumber	1

The first three subscribers are appointed directors; qualification, £500 in shares or stock. The company in general meeting will determine remuneration.

Delagoa Bay and East African Railway Company, Limited.

This company proposes to acquire a concession granted by the Portuguese Government on the 14th December, 1883, and the benefits and conditions of a contract of the same date between the said Government and Edward McMurdo, for the construction and working of a railway from Delagoa Bay to the boundary line of the South African Republic, and to take over ten miles of the said railway already constructed. It was registered on the 3rd inst., with a capital of £500,000, in £10 shares. The subscribers are:—

	Shares.
W. Powter, 21, Gotha-street, South Hackney, secretary	1
G. H. Newman, 47, Walterton-road, Westbourne Park, secretary	1
E. J. Churchouse, 61, Almack-road, Clapton, clerk	1
J. M. Alprovidge, 72, Lenthall-road, E.	1
G. E. D Durnford, 10, Clarendon-villas, Old Charlton, accountant	1
A. Evans, 89, Brook-street, Commercial-road, shorthand writer	1
J. Owen, 12, New North-street, W.C., clerk	1

The number of directors is not to be less than three, nor more than thirteen, one of whom may be appointed by the King of Portugal. The subscribers are to appoint the first directors, and are to determine their qualification and remuneration, and are themselves to act as directors *ad interim*. The first solicitors and the secretary will also be appointed by the subscribers. The three largest shareholders for the time being who are not directors will form a permanent committee for the purpose of consulting and advising with the board on such matters as may be submitted to them by the board.

Liverpool Cool Air Drying Company (Jennings' Patents), Limited.

Registered on the 5th inst., with a capital of £5000, in £5 shares, to carry on business as dryers of all classes of goods and materials. The subscribers are:—

	Shares.
*J. H. Hale, St. Andrew's Wharf, Upper Thames-street, cement manufacturer	40
*A. Kimber, 3, Roland-gardens, S.W.	40
*Wm. Webb, 3, George-yard, Lombard-street, metal merchant	40
R. T. Churchill, 100, South Hill Park, Hampstead, civil servant	20
*A. L. Sacre, 60, Queen Victoria-street, engineer	40
*S. Slater, 32, Queen Victoria-street, accountant	40
A. J. Slater, 32, Queen Victoria-street, accountant	40

The number of directors is not to be less than three, nor more than seven; qualification, 25 shares; the first are the subscribers denoted by an asterisk, and Messrs. Fredk. Braby, Bushey Lodge, Teddington, and H. Wilson Hart, of 2, Neville-street, Onslow-square. The company in general meeting will determine remuneration.

Mechanical Appliances Syndicate, Limited.

This company was registered on the 9th inst., with a capital of £20,000, in £10 shares, to acquire letters patent for improvements in door stops or checks. The subscribers are:—

	Shares.
F. J. Dove, Stud-street, Islington, contractor	10
T. F. Rider, 181, Union-street, Southwark, contractor	10
Rev. S. W. D. Fox, 49, Bedford-gardens, W.	10
A. Hansfeld, 57, Bryston-road, N.	1
C. Wallington, 3, Tokenhouse-buildings, chartered accountant	10
C. J. Plint, Elm-grove, Peckham	1
H. V. Johnson, 3, Torrens-road, Brixton-hill	1

The number of directors is not to be less than three, nor more than seven. Most of the regulations of Table A apply.

Patent Process Dyeing Company, Limited.

This company was registered on the 2nd inst., with a capital of £5000, in £10 shares, to acquire the patent rights of Ely Sutcliffe and George Edward Sutcliffe, for improved means of dyeing slivers of woollen, worsted, alpaca, and mohair, for the purpose of making coloured yards. The subscribers are:—

	Shares.
*G. Ashworth, Collyhurst, Manchester, machine maker	17
*E. Ashworth, Collyhurst, Manchester, machine maker	17
*G. A. J. Schott, Bradford, fancy yarn manufacturer	17
C. Brumm, Bradford, merchant	17
T. England, Halifax, solicitor	17
F. Foster, Halifax, sharebroker	17
J. Duff, Halifax, chartered accountant	1

The number of directors is not to be less than three, nor more than seven; qualification, 10 shares; the first three subscribers and the vendors are the first directors.

Regenerative Electric Light Company, Limited.

This company was registered on the 7th inst., with a capital of £50,000, in £1 shares, to acquire the sole license for Great Britain and Ireland, other than Scotland, of the following letters patent:—No. 1464, dated 27th March, 1882, for the patent process of Felix de Lalande, for electric piles or batteries; No. 40, dated 1st January, 1884, for improvements in galvanic batteries, and the utilisation of the products therefrom. The company further proposes to purchase such of the assets and property of the Standard Electric Light and Power Company, Limited, as may be necessary for the business of the company. The subscribers are:—

	Shares.
C. A. Morgan, 17, Cornhill, clerk	1
G. S. Harrison, 26, Stonor-road, West Kensington, clerk	1
R. Toulson, Wellington-road, West Croydon, cashier	1
H. A. Neeve, Bushey Green, Catford, clerk	1
A. E. Downes, Stanford-road, New Southgate, clerk	1
H. Bennett, Sunny Bank, West Norwood, clerk	1
J. Milligan, jun., 62, Victoria-street, Windsor, clerk	1

Registered without special articles.

Windsor Hemp and Wire Rope Company, Limited.

This company was registered on the 3rd inst., with a capital of £15,000, in £10 shares, to trade as hemp and wire rope manufacturers in all branches. The subscribers are:—

	Shares.
H. L. Lace, Cardiff, engineer	10
H. T. Box, Cardiff, cement manufacturer	10
W. T. Jones, Cardiff	10
J. H. Plews, Cardiff	10
J. E. Gunn, Cardiff, accountant	1
J. Morgan, Cardiff, traveller	10
W. F. Gillet, Cardiff, architect	10

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

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

8th March, 1887.

3480. LIFE BUOYS, W. Schermuly, London.
3481. PIANOFORTES, A. L. Krom, London.
3482. LAMPS, C. Warren, London.
3483. CASTORS, H. B. Harding, Birmingham.
3484. SPINNING COTTON, H. Stevenson, J. Webb, and S. Hallam, Manchester.
3485. SPINNING COTTON, D. Nicholls, Manchester.
3486. DOOR CHECKS, &c., G. F. Newman, Birmingham.
3487. HYDROCARBON, &c., LAMPS, D. B. Morison and G. J. Purser, Birmingham.
3488. DOOR SPRING, S. Hill, Birmingham.
3489. HAIR CLIPPERS, T. L. Phipps and W. Burman, Birmingham.
3490. INK-ERASERS, M. W. Samuel.—(*S. V. Essick, United States.*)
3491. PATENT TOBACCO SMOKING PIPE, H. Koppenhagen, London.
3492. BUTTON-HOLE STITCHING MACHINE, T. W. Marshall, London.
3493. COOKING-RANGES, J. C. Parker, Glasgow.
3494. FILLING INTERNALLY-STOPPERED BOTTLES with AERATED LIQUIDS, A. E. H. Lozé, Liverpool.
3495. SEPARATING, &c., NEWLY-MADE BRICKS, W. Donnelly, Liverpool.
3496. HORSE-COLLARS, W. Harley.—(*S. B. Davis, United States.*)
3497. BICYCLE RAILWAY SYSTEM, E. M. Boynton, London.
3498. JUBILEE LEAF TURNER, J. and J. G. Shaw, Blackburn.
3499. FILTERING WATER, &c., J. P. Jackson, Liverpool.
3500. BICYCLES, J. Brusie, London.
3501. FIXING a METALLIC TABLET to SUPPORTS in the EARTH, C. E. and J. R. Clive, Birmingham.
3502. METAL HANDLE, C. E. and J. R. Clive, Birmingham.
3503. TEACHING the PLAYING of the PIANO, S. Gilham, Newcastle-on-Tyne.
3504. SEWING BOOTS, F. A. Hinks and W. H. Dorman, Stafford.
3505. CANDLESTICK, T. R. Weston, London.
3506. PROPELLING APPARATUS for SHIPS, A. H. Farrow, London.
3507. WALLS of HOUSES, &c., J. Pope, Folkestone.
3508. LIFE-SAVING SEATS for SHIPS, J. G. W. Aldridge, Southampton.
3509. BUTTONS, E. Brill, Manchester.
3510. VELOCIPEDES, H. J. Lawson, Coventry.
3511. STEAM, &c., ENGINES, T. Hunt, Manchester.
3512. STEP LADDERS, &c, A. E. Kitson, Skipton-in-Craven.
3513. DRIVING BELTS, J. K. Tullis, Glasgow.
3514. MANGLING MACHINES, H., J., and W. Whittaker, and T. Bradley, Halifax.
3515. LOCKING NUTS, S. D. Blogg, London.
3516. RIM-LOCKS, W. Sturmey, Birmingham.
3517. PAVEMENTS, R. Thomson, Glasgow.
3518. PRODUCING RIPPLED, &c., PATTERNS upon ROLLED PLATE GLASS, A. D. Brogan and A. M. Mallock, Glasgow.
3519. PRODUCING RIPPLED, &c., PATTERNS upon ROLLED PLATE GLASS, A. D. Brogan and A. M. Mallock, Glasgow.
3520. DISCHARGING JETS, J. Cockburn, Glasgow.
3521. MANUFACTURING CHAIN, A. A. C. Suggate, Lewisham.
3522. TABLES, M. Wells and T. Walls, London.
3523. PREVENTING the BREAKING of FEEDING-BOTTLES, J. W. Brown, London.
3524. CARDING ENGINES, R. Wilson and J. Wood, London.
3525. LOOMS, T. C. Barraclough.—(*B. Arnold, United States.*)
3526. SUGAR, A. E. Major, London.
3527. PROPELLING BOATS, L. P. Allen.—(*M. Muret, New Zealand.*)
3528. ACTION for ORGANS, H. Sampson, London.
3529. SAFETY VALVE, S. J. White, London.
3530. PHOTOGRAPHIC FILMS, A. J. Boult.—(*G. Eastman, United States.*)
3531. TESTING GASES, T. Shaw, London.
3532. LAMPS, J. A. H. Leynen-Hougaerts, Liverpool.
3533. RAILWAY SIGNALLING, A. M. Clark.—(*J. D. Gould, United States.*)
3534. TWISTING MACHINES, L. Binns, London.
3535. LATERAL SEE-SAW ACTION CYCLISTS' SADDLE, A. B. Smith, London.
3536. DIAMOND SAW-PLATE, B. Walchner, London.
3537. SUSTAINING WINDOW-SASHES at any DESIRED HEIGHT, W. Burnet and D. Petrie, London.
3538. WINDOW FASTENERS, E. Dummer, London.
3539. STEAM FEED-WATER TRAPS, J. G. Tongue. —(*H. Creamer, United States.*)
3540. SAFETY RAZOR, J. G. Tongue.—(*F., O., and R. Kampfe, New York.*)
3541. TREATING FABRICS for DYEING, W. Walker and J. Drenchfield, London.
3542. ARITHMOMETERS, J. Rettie, London.
3543. SELF-GENERATING GAS-BURNERS, R. Wallwork and A. C. Wells, Manchester.
3544. LABELS, S. J. Edelsten, London.
3545. MUSICAL BOXES, E. de Pass.—(*C. Paillard et Cie., Switzerland.*)
3546. STAMP POCKETS, W. J. Downes, London.
3547. SECURELY FASTENING ENVELOPES, E. J. Oliver, London.
3548. DECORTICATING FIBROUS PLANTS, H. H. Lake.—(*B. F. Jonas, United States.*)
3549. STAND for SMOOTHING-IRONS, H. H. Lake.—(*R. Crommer and A. H. Philips, United States.*)
3550. TORPEDO, J. P. Gibbins, London.
3551. FLOATING ELECTRO AUTOMATIC MINE, J. P. Gibbins, London.
3552. SUSPENDING METALLIC DISCS, &c., J. P. Smith, London.
3553. REGULATING the SUPPLY of GAS to GASALIERS, J. Breeden, London.
3554. LUCIFER MATCHES, J. Fraser, London.
3555. COUPLING SHAFTS to DRIVING PULLEYS, J. Richardson and W. D. Wansbrough, London.

9th March, 1887.

3556. INDICATING LABEL for KEYS, J. R. Cleave, London.
3557. MECHANICAL WALKING TOYS, R. L. Grainger, Dumbarton.
3558. MEASUREMENT of MILK, J. Ralls, Bridport.
3559. CURE for TOOTHACHE, &c., F. Kellet, Dublin.
3560. HOLDERS for ELECTRIC LAMPS, E. C. Warburton, Manchester.
3561. ROLLERS for DYEING, &c., FABRICS, A. Birch, Manchester.
3562. SAFETY BENZOLINE LAMP, W. G. Ackerman and G. H. Best, Bridport.
3563. COVERING ROLLERS, P. Bowden, Bolton.
3564. MARKING CIGARS, O. Barnsdale, Nottingham.
3565. MEASURING INDICATOR CARDS, W. Kimley, Liverpool.
3566. BRUSH, H. Ainley, Halifax.
3567. FRETS for VIOLINS, &c., W. Ritchie, London.
3568. ARTIFICIAL STONE, G. G. Girling, Lenham.
3569. LAMPS, W. Wells, Glasgow.
3570. BORING TOOLS, G. W. Green, Birmingham.
3571. LIQUID FUEL, W. P. Thompson.—(*I. D. Smead, United States.*)
3572. LAMPS, A. Horne, Liverpool.
3573. SHIELD for LAMPS, J. L. Parker, Longport.
3574. FASTENINGS for WINDOWS, B. Cassidy and J. Woodfield, Birmingham.
3575. DRIVING GEAR for BICYCLE, J. Whittle, Preston
3576. ROCK DRILLS, R. Thompson and H. Gibson, jun., Newcastle-on-Tyne.
3577. WICKET, A. J. Altman, London.
3578. TRICYCLE CARRIAGE, J. E. Thorpe, London.
3579. COMBINATION WHEEL LOCKS, J. R. Mayfield, Hemel Hempstead.
3580. TORPEDO INDICATING LIGHT GEAR, J. S. Comrie London.
3581. TARPAULIN for WAGONS, &c., F. Pegler, London.
3582. BICYCLES, &c , A. Hunnable, London.
3583. TREATMENT of ALUMINA, A. A. Croll, London.
3584. CANDLESTICKS, J. Brindle, London.
3585. LIFE COLLARS, &c., R. D. Kay, London.
3586. CABINETS, J. T. Hoyt and J. R. Anderson, London.
3587. SASH PULLEYS, E. O. Eaton.—(*Partly communicated by J. Lancaster, New York.*)
3588. DRIVING DYNAMO-ELECTRIC MACHINES, G. Tangye and T. Jefferiss, London.
3589. ABDOMINAL BELTS, J. W. Teufel.—(*W. Teufel, Germany.*)
3590. LADIES' BREAST IMPROVERS, J. W. Teufel, London.
3591. PROJECTILES, H. H. Lake.—(*G. F. Simonds, United States.*)
3592. MARGARINE, &c , H. N. Hillman and G. B. Kleinpass, London.
3593. PRINTING MACHINES, W. S. Foord, London.
3594. HOSE COUPLINGS, J. C. Hudson, London.
3595. VENTILATING APPARATUS, R. S. Ash, London.
3596. COLLAPSIBLE KNAPSACK, &c., H. J. Rose, London.
3597. BREAD RAISING and BAKING in OVENS, T. Rickett, Southampton.
3598. MACHINES for MAKING METAL TIMBER HANGERS, &c., J. Russell, G. M. Ball, H. W. Redfield, and J Cooper, London.
3599. MUSIC CASE and BAG COMBINED, W. J. Downes, London.
3600. BOOTS and SHOES, A. Keats, London.
3601. CUTTING PRESSES, J. and A. Keats, London.
3602. LOCKING and RELEASING the FACING POINTS of RAILWAYS, G. Edwards, London.
3603. RAILWAY CAR COUPLERS, P. Haddan.—(*J. S. Andrews, Canada.*)
3604. BUOYANT SAFETY SWIMMING DRESS, L. Grünfelder, London.
3605. SIMULTANEOUS TELEGRAPHY and TELEPHONY, C. Selden, London.
3606. STOPPERS for BOTTLES, &c., F. McIlvenna and A. Schofield, London.
3607. VELOCIPEDES, C. M. Linley and J. Biggs, London.
3608. DYNAMO-ELECTRIC MACHINES, J. D. F. Andrews, London.
3609. DYNAMO-ELECTRIC or MAGNETO-ELECTRIC MACHINES, D. Halpin and I. A Timmis, London.
3610. CLIPS for AXLES, &c., E. Partridge, Edgbaston.
3611. LAYING ELECTRICAL CONDUCTORS UNDERGROUND G. Forbes, London.

10th March, 1887.

3612. LACING-HOOKS for BOOTS, &c., F. Moore, jun. Birmingham.
3613. TRAVELLING FLAT CARDING ENGINES, H. Stevenson, F. W. Ewen, J. Webb, and S. Hallam, Manchester.
3614. STEAM TRAPS, W. Hartcliffe and W. H. Malkin, Manchester.
3615. HARMONIOUS COLOURING, C. H. Wilkinson, Manchester.
3616. BRASS-MOUNTING IRON BEDSTEADS, T. Perry and Son and H. W. Hawkins, London.
3617. SEPARATING OILS of DIFFERENT SPECIFIC GRAVITIES, A. F. Craig, A. Neilson, and J. Snodgrass, Glasgow.
3618. WASHING, BOILING, and RINSING MACHINES, T. Bradford, Manchester
3619. CHURNS, T. Bradford, Manchester.
3620. PULLEYS and DRUMS, R. R. Gubbins London.
3621. HYDRANTS, &c., for SUPPLYING WATER, C. G. Schmidt, London.
3622. CURTAIN RODS, E. Griffiths, London.
3623. BOILING SIZE, J., E., and J. Pickup, Manchester.
3624. HINGE for LADDERS, J. B. Summerscales and J. Rhodes, Halifax.
3625. DRYING TEXTILE FABRICS, W. M. Riddell, London.
3626. SLIDING POCKET KNIFE, G. Roe, Dublin.
3627. HAULAGE CLIP, J. Hill, Derby.
3628. ADJUSTING the TENSION of WIRE MATTRESSES W. L. Pearson and W. Heffernane, Dublin.
3629. REGISTERING and RECORDING APPARATUS, G. W. Coombes, Birmingham.
3630. LADDERS, T. Jones, Sedley.
3631. DRY ASHPITS, &c., P. J. Preston, Batley.
3632. PERFECTING LETTER-PRESS MACHINES, G. Newsum, Bradford.
3633. STOP MOTIONS for LOOMS, H. Butler, London.
3634. HYDRAULIC LIFTS, C. F. Archer, London.
3635. SPINNING, &c., MACHINES, A. McCulloch, A. Carrie and D. Ogilvie, Dundee.
3636. MUSIC STANDS and STOOLS, W. S. Riley, Birmingham.
3637. LAMPS, W. Andrew and A. W. Turner, Birmingham.
3638. WATCH KEY, J. Dailing, Glasgow.
3639. SELF-ACTING TWISTED HEALDS, J. Appleyard, Bradford.
3640. MAGAZINE REPEATING RIFLES, A. H. Oakden, Grimsby.
3641. COCOA-NUT CAKE, J. Williams, London.
3642. PICKERS used in LOOMS for WEAVING, J. Ingham, J. Ingham, H. Ingham, and J. Morton, Bradford.
3643. GAS LAMPS, A. H. Hearington, London.
3644. ROTARY PUMPS, J. Cooper, London.
3645. OILING RAGS, C. Wilcock, London.
3646. PLATES and HEELS for BOOTS, &c., W. Fillingham and R. Fillingham, Sheffield.
3647. SEPARATING SOLIDS from LIQUIDS, C. H. Roeckner, F. L. Roeckner, and R. L. Roeckner, Tynemouth.
3648. BOILERS, F. Wilkins, London.
3649. ATTACHMENTS for EXTINGUISHING OIL LAMPS, J. H. Barry, London.
3650. SPRING BALANCES, B Field, London.
3651. TESTING the STRENGTH of INDIVIDUALS, T. V. Riordan, London.
3652. PRINTING from PHOTOGRAPHIC NEGATIVES, N. S. Brown, Kirkaldy.
3653. MOUTHPIECE for SPEAKING TUBES, S. Smith, London.
3654. LOCK NUT, G. A. Goodwin and W. F. How, London.
3655. EAR TRUMPETS, A. J. Boult.—(*E. A. Williams, United States.*)
3656. FRAMEWORK FENCING, F. Sage, London.
3657. LUBRICATORS, W. S. Chantrell, Liverpool.
3658. ALTERNATING CURRENT TRANSFORMERS, R. Dick and R. Kennedy, Glasgow.
3659. SAFETY RAZORS, F. Lawrence.—(*G. Rein, St. Louis.*)
3660. REVERSING the ACTION of ENGINES, G. F. Redfern.—(*N. Fouquemberg, Belgium.*)
3661. HORSE GEAR, A. P. S. Davies and J. P. Baillie, London.
3662. FINISHING, &c., TEXTILE FABRICS, W. Baxter, Bradford.
3663. FOLDING PAPER, &c., J. Wetter.—(*H. Stamm, France.*)
3664. BOOT and SHOE MACHINERY, J. H. S. Evans, London.
3665. COMBING MACHINES, J. Pickles and H. W. Whitehead, London.
3666. STEAM ENGINES and GENERATORS, H. Turner, Liverpool.
3667. PRODUCTION of FRESH WATER from SALT WATER, F. Hocking, Liverpool.
3668. JOINTS for STEAM PIPES, &c., S. H. Smith and H. Lane, London
3669. EXTRACTION, &c., of METALS, C. B. Schultze, London.
3670 CAST STEEL, F. H. Lloyd and H. White, London.
3671. ILLUMINATING GLASS, J. Breeden, London.

3672. Draw or Blow-off Valve or Cock, S. Wilkerson, London.
3673. Projectiles, A. V. Newton.—(*A. Nobel, France.*)
3674. Compensating for the Recoil of Guns, A. V. Newton.—(*A. Nobel, France.*)
3675. Explosive Compounds, A. V. Newton.—(*A. Nobel, France.*)
3676. Detonators, A. V. Newton.—(*A. Nobel, France.*)
3677. Measuring Pump, W. B. F. Sims, J. Loweth, C. H. Ginkins, D. M. Rowland, J. P. Funk, and A. Lawson, London.
3678. Treating the Seed of the Fruit of a Certain Tree, S. H. Levi, London.
3679. Steam Presses for Lace Goods, C. J. Cox, London.
3680. Dressing &c., Piassava, &c., H. E. Ludbrook, London.
3681. Variable Cut-off Gear, A. H. Charters, London.
3682. Roundabouts, F. Savage, King's Lynn.
3683. Grinding Small Articles, S. H. Hodges, Street.
3684. Artificial Ear Drums, H. H. Lake. -(*F. Hiscox, United States.*)
3685. Conveying Grain, &c., J. Schlesinger, London.
3686. Sewing Machines, C. Bradbury. —(*Messrs. Grimme, Natalis, and Co., Germany.*)
3687. Oil or other Lamps, S. A. Johnson, London.
3688. Thermopiles, G. E. Dorman, Stafford.

11*th March*, 1887.

3689. Surfacing Curved Glasses, W. H. Beck.—(*La Société F. Benoist et L. Berthiot, France.*)
3690. Rim Locks, H. T. Owens, Birmingham.
3691. Railway Wagon Couplings, &c., C. F. L. May, London.
3692. Operating Trap Levers of Twisting Frames, P. Smith, jun., London.
3693. Picker for Power Looms, R. Ashworth, Preston.
3694. Cushion Carriers for Seats, G. and E. Woods, Liverpool.
3695. Raising, &c., Galleries of Oil Lamps, E. Rutter and G. Foggs, Glasgow.
3696. Dephosphorating Iron, &c., C. B. Phillips, Chester.
3697. Potato Masher, S. E. Jackson, Oldham.
3698. Gumming, &c., Envelopes, J. Anderson, Newcastle-on-Tyne.
3699. Electric Arc Lamps, L. Hanson, Halifax.
3700. Fabric for Surgical, &c., Purposes, T. Barker, Halifax.
3701. Heating Feed-water, &c., A. MacLaine, Belfast.
3702. Velvets, &c., J. Cook, Eccles.
3703. Shields for the Heads of Infants, T. Needham, Halifax.
3704. Treatment of Cupreous Pyrites, J. and J. Hargreaves and T. Robinson, Liverpool.
3705. Compound Steam-air Engines, W. Schmidt, Berlin.
3706. Covers of Ships' Hatchways, &c., T. R. Fox, Higher Tranmere.
3707. Self-extinguishing Dome for Lamps, C. E. Postlethwaite, London.
3708. Cooking Ranges, G. G. Brodie, Aston, and J. D. Prior, London.
3709. Clips for the Insides of Cigar, &c., Cases, H. Alliday, London.
3710. Speculums, J. W. McCall, London.
3711. Rollers for Window Blinds, C. F. Snee, London.
3712. Rope Stoppers, T. Archer, jun., Newcastle-on-Tyne.
3713. Drawing Raw Wool, W. Spence.—(*P. Dubois, France.*)
3714. Trouser Protectors, H. S. Dean, London.
3715. Treatment of Exogenous Plants, &c., J. Longmore and W. L. Watson, London.
3716. Spanners, &c., E. Willars, London.
3717. Uppers of Boots, W. H. and W. Poole, Southsea.
3718. Combined Rack for Soap, &c., J. D. Tucker, London.
3719. Steeping Flax, P. Parsy, London.
3720. Tin Openers with Corkscrews, W. Oates, Sheffield.
3721. Windlasses or Hoisting Apparatus, W. Seeglitz, London.
3722. Railway Chairs, &c., T. and C. Dodsworth, London.
3723. Arresting the Descent of Cages, J. Holcroft, London.
3724. Actuating Window Blinds, &c., G. Dyson, London.
3725. Wagonettes, &c., W. G. Wright, London.
3726. Inhalation of Medicinal or other Matters, J. Cama, London.
3727. Buckets for Containing Cement, &c., J. M. Carr, London.
3728. Compound Steam Engines, A. V. Newton.—(*J. Ericsson, United States.*)
3729. Supplying Liquid to Steam Boilers, A. Mayhew, London.
3730. Apparatus for Testing Physical Strength, J. M. O'Kelly, London.
3731. Starting Gas and Oil Motor Engines, F. W. Crossley, London.
3732. Heat Engines, W. A. G. Schönheyder, London.
3733. Mounting Guns, A. Moncrieff, London.
3734. Knitting Machinery, H. J. M. Melor, Nottingham.
3735. Envelopes, C. S. Musgrave, London.
3736. Abdominal Belts for Reducing Corpulency, L. Schaffer, London.
3737. Rotary Valves, D. Purves, London
3738. Steel and Ingot Iron, P. M. Justice.—(*H. T. Rode, Germany.*)
3739. Toy, A. L. Mora, London.
3740. Mortar Mills, W. Eddington, London.
3741. Extracting Tin, O. Hehner and T. H. Cobley, London.
3742. Felts, G A. Herdman, London.
3743. Sugar Tongs, &c., H. A Couchman and H. Armstrong, London.
3744. Valve-gear, J. Richardson and B. R. Rowland, London.
3745. Illumination Devices, G. E. Forrest, London.
3746. Feeding Torpedoes, W. C. Storey and G. Poore, London.
3747. Submarine Vessels, W. C. Storey and G. Poore, London.
3748. Sewing, H. H. Lake.—(*A. C. Saxton, United States.*)
3749. Electrical Apparatus, M. Kotyra, London.

12*th March*, 1887.

3750. Rafts, E. S. Copeman, London.
3751. Lamp, S. Harris, Truro.
3752. Sockets, P. Gallimore, Birmingham.
3753. Dyeing, J. Burn, Bradford.
3754. Work-bench, M. L. Hall, Manchester.
3755. Taps, J. R. Hargrove, Birmingham.
3756. Safety Cage, C. C. Elliott, Sheffield.
3757. Hanging Doors, W. S. Pilditch, London.
3758. Pen-holders, J. L. Petit, Bloxwich.
3759. Horse-shoe, J. Nunn, Middlesbrough.
3760. Music Desks, W. S. Riley, Birmingham.
3761. Fibres, J. and J. A. Leeming, Halifax.
3762. Pulleys, &c., J. E. Farrer, Sheffield.
3763. Securing Lids of Boxes, A. Milne, Newcastle-on-Tyne.
3764. Gas, J. F. Shaw and J. C. Rhodes, Manchester.
3765. Tills, J. E. Farrow, Birkdale.
3766. Scarf Adjustment, F. L. Steer, London.
3767. Arc Lamp, J. Lea, London.
3768. Slicing Bread, J. Darling, Glasgow.
3769. Preventing Over-winding, T. Smith, Lancashire.
3770. Bulb, C. B. S. Webb, Colchester.
3771. Tide Trap, J. J. Arnold, Lincoln.
3772. Trimming Lamp Wicks, W. H. Morrison, London.
3773. Sheet Metal Boats, J. White, London.
3774. Wheel Tires, W. Fox, London.
3775. Cycles, M. Hedderwick and R. S. Crawford, Glasgow.
3776. Securing Rubber Tires to Channel-section Metal Tires of Wheels, F. and C. Forder, London.
3777. Cooking Ranges, S. B. Goodwin, W. Barsby and R. Pochin, London.
3778. Matches, &c., W. W. Walker and E. A. McAdam, Liverpool.
3779. Ventilators for Hats, C. A. Roepke, London.
3780. Padlocks, J. Frakes and J. Lowe, London.
3781. Thermopiles, G. E. Dorman, Stafford.
3782. Electric Telegraphs, E. Edwards.—(*D. Kunhardt, Germany.*)
3783. Morse Keys, E. Edwards.—(*E. Cassalette and D. Kunhardt, Germany.*)
3784. Electric Railway Signals, E. D. Wells, London.
3785. Junction and Testing Boxes for Electrical Conductors, E. W. Beckingsale.
3786. Bellows for Reed Instruments, W. G. Ackerman and G. H. Best, London.
3787. Burnishing Machine, W. W. Horn.—(*G. B. Kelley, United States.*)
3788. Producing Motive-power, R. G. Laird, London.
3789. Register and other Fire-grates, H. Hunt, London.
3790. Electrical Station Indicator, F. B. Nicholson, London.
3791. Protection of Fowls, &c., from Vermin, R. Haddan.—(*C. Haunstrup, Denmark.*)
3792. Electrical Fire Alarum, H. S. Petit and H. S. Bresson, London.
3793. Refrigerating Apparatus, J. Imray. —(*La Compagnie Générale pour la Production du Froid Procedes, E. Fixary, France.*)
3794. Novel Transparent Protective Enamel, T. Garton, London.
3795. Tool Holder for Lathes, &c., G. Rydill, London.
3796. Generating Electricity by the Direct Combustion of Carbon Fuels, G. C. Fricker, London.
3797. Continuous Brake Apparatus worked by Compressed Air, A. P. Kapteyn, London.
3798. Velocipedes, F. Tentschert, London.
3799. Marking Boards for Scoring at Billiards, T. Campbell, London.
3800. Cleansing Clothing, F. J. Brougham.—(*E. Desjardines, Paris.*)
3801. Advertisements, &c., C. E. Hall, London.
3802. Felt Hats, B. Herzberg, London.
3803. Encaustic Tiles, F. Frenzel, London.

14*th March*, 1887.

3804. Filtering Apparatus, J. Howes, Liverpool.
3805. Extinguishers for Lamps, F. R. Baker, Birmingham.
3806. Tricycles, W. D. Bohm, London.
3807. Preventing Snarling during Winding Cotton, J. and W. Schofield, Waterhead.
3808. Gas Engines, R. McGhee, Shawlands.
3809. Semi-Duplex Screw Propeller, M. and T. H. Scarth, Southwick.
3810. Burning Oils, &, J. Howie, Glasgow.
3811. Obtaining Electricity, T. R. Western, London.
3812. Stoppers for Bottles, T. Murphy, Ireland.
3813. Organs, H. Fordham, London.
3814. Showing Names, &c., on Blocks, &c., G. H. Wildsmith, Leeds.
3815. Combination Ware, T. Harrison, Arnside.
3816. Inhaling Vapour of Chloride of Ammonium, J. W. Pownall, Manchester.
3817. Fire Grate, J. Wright, Manchester.
3818. Suspender for Pictures, &c., G. E. Mewis, London.
3819. Inkstands, &c., A. Davis, London.
3820. Spinning Jute, &c., W. R. Laing, Glasgow.
3821. Damping Dust in Mines, H. W. Martin and J. Turnbull, London.
3822. Hearth for Fireplaces, W., T., A., and H., Bell, London.
3823. Electro-magnetic Marine Governors, G. A. Smith, London.
3824. Certain Cure for Toothache, W. Wilson, London.
3825. Continuous Pin, W. Burton, New Barnet.
3826. Self-acting Buckle, S. S. Bromhead, London.
3827. Automatic Signalling Apparatus, H. R. Landon, W. T. W. Thackeray, and J. Richardson, London.
3828. Cases for Jewellery, T. P. Hughes, London.
3829. Pumps, E. Hübner, Liverpool.
3830. Couplings for Railway Carriages, &c., W. G. Stuart, London.
3831. Transforming Electric Currents, F. C. Phillips and H. E. Harrison, London.
3832. Lubricant, A. G. Wass, London.
3833. Lubricant, A. G. Wass, London.
3834. Oil Lamps, &c., A. E. Webb, H. J. R. Johnstone, and H. W. Paul, London.
3835. Grating Cheese, F. Fissi, London.
3836. Sewing Machinery for Hem Stitch, J. Heggan, London.
3837. Attaching Buttons to Cloth, W. Martin, London.
3838. Lifting Jacks, G. King, London.
3839. Injectors for Feeding Steam Boilers, &c., W. S. Tomkins, London.
3840. Mechanism of Locks, S. and A. Collett, London.
3841. Heating Water, J. Cumming, F. N. Fennell, and G. F. Fennell, London.
3842. Bolt for Fish-plates, &c., J. J. Bodmer, London.
3843. Refrigerating Materials, G. Downing.—(*H. T. Baeschlin, France.*)
3844. Button-hole Scissors, L. V. Rees and S. H. Levi, London.
3845. Packing-cases or Boxes, G. T. Tasman, London.
3846. Link-motion, F. R. Cox, London.
3847. Boots and Shoes, H. Efflandt, London.
3848. Filtering Apparatus, C. J. Bühring, London.
3849. Preventing the Explosion of Steam Boilers, &c., B. Meyer, London.
3850. Shop Fronts, J. Gooch, London.
3851. Combination Season Ticket and Case, H. H. Leigh —(*J. V. Marchesson and J. Nicolas, France.*)
3852. Rotary Engines, C. Griffin, London.
3853. Boilers, H. Corden, London.
3854. Weighing Machines, F. Casse, London.
3855. Coupling Apparatus for the Shafts of Vehicles, J. A. Berg, London.
3856. Filaments of Carbonisable Material, T. V. Hughes, London.
3857. Heel Plates for Boots and Shoes, G. Randall, London.
3858. Drawing Corks from Bottles, W. H. Mason. —(*J. Bloeser, United States.*)

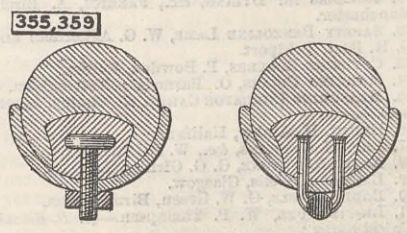
SELECTED AMERICAN PATENTS,

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

355,359. Device for Fastening Rubber Tires to Wheels, *J. A. Turner, Passaic, N.J.—Filed July 22nd*, 1886.

Claim.—The combination, with a soft or flexible rubber tire, of pieces of hard rubber containing fasten-

355,359

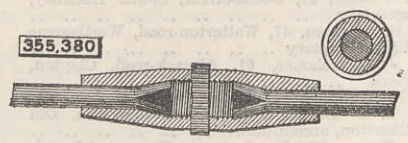


ings adapted to pass through holes in the rim or felly of the wheel, said hard rubber pieces being vulcanised in the soft rubber tire, substantially as herein described.

355,380. Coupling for Electric Conducting Wires, *G. A. Carpenter, Providence, R.I.—Filed October 15th*, 1886.

Claim.—In a coupling for electrical conducting wires, the combination of the sleeves adapted to be secured together and having the enlarged or flared openings at

355,380

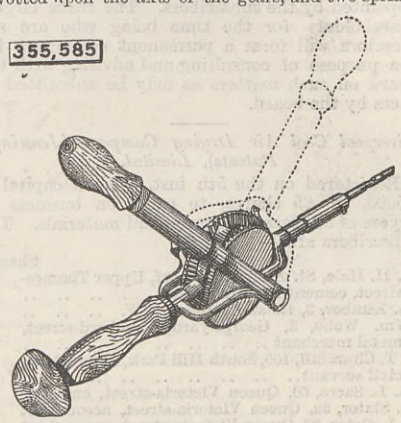


their inner ends, the wires in the sleeves, and the wedges driven into the inner ends of the wires to form enlarged heads thereon, for the purpose set forth, substantially as described.

355,585. Hand Drill, *D. A. A. Buck and A. A. Buck, Cheshire, Conn.—Filed August 26th*, 1886.

Claim.—A ratchet drill in which are combined two oppositely arranged bevel gears that engage with an interposed bevel pinion, a reciprocable lever which is pivotted upon the axis of the gears, and two spring-

355,585

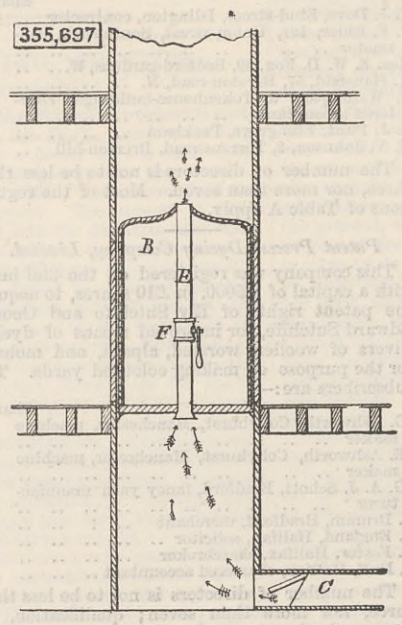


actuated pawls that are independently pivotted between the latter upon an axis having a right angle to the axis of the same, and are each adapted to be moved into or out of contact with the teeth of either of said gears, and when in such contact to alternately engage with or ratchet over said teeth as said lever is reciprocated upon its axial bearings, substantially as and for the purpose specified.

355,697. Pneumatic Elevator, *J. Mabbs, Chicago, Ill.—Filed August 5th*, 1886.

Claim.—(1) The combination, with an elevator shaft having direct connection at its lower end with air compressing mechanism, of an elevator car fitting and moving in said shaft and an air passage carried through said car and discharging into the shaft above

355,697

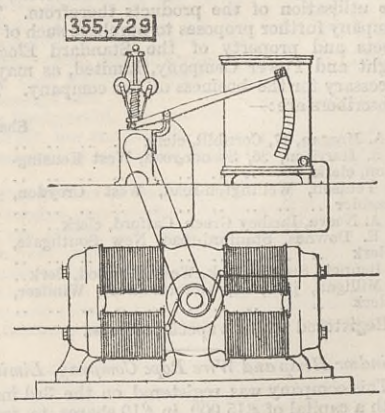


the same, substantially as described. (2) The combination, with an elevator shaft, having connection at its lower end with a flue, C, for compressed air, of a car B, fitting and moving in said shaft, an air passage or tube, E, passing through the car and opening below and above it, and shut-off or valve, F, substantially as described.

355,729. Regulator for Electro Magnetic Motors, *W. L. Stevens, Dorchester, Mass.—Filed April 26th*, 1886.

Claim.—In a motor regulator, the combination, with an automatically moved or operated contact arm, of a rheostat having a series of contact or terminal plates,

355,729

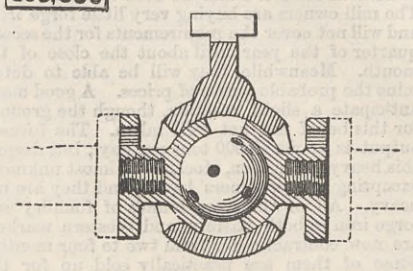


the first plate of the series being much longer than the others, and all the plates being connected together by intermediate resistance coils, as and for the purpose set forth.

356,099. Thrust Bearing Journal Box, *G. M. Clark, Higganum, Conn.—Filed September 3rd*, 1886.

Claim.—(1) The combination, substantially as hereinbefore described, of a ball, a journal box inclosing said ball, a cup-shaped bearing seat within said box, and a cup-shaped thrust bearing which is fitted to said ball, whereby regardless of variations in the direction of thrusting force, said ball will afford shifting contacts to both of said cup-shaped seats. (2) The combination, substantially as hereinbefore described, of a journal box, a pair of revolving shafts each provided with a cup-shaped seat and occupying portions of said box, and a ball interposed between said shaft seats and within said box, whereby thrusting strains upon said shafts, or either of them, toward said box is borne by said ball, and the contact surfaces of said ball constantly shifted. (3) The combination, with a journal box, of

356,099

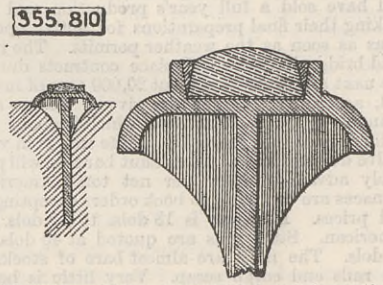


a pair of interior concave or cup-shaped seats and an interposed hollow perforated ball, substantially as described, whereby said ball may be charged with a lubricant for gradual delivery.

355,810. Street or other Curb, *E. L. Brown, Chicago, Ill.—Filed September 17th*, 1886.

Claim.—(1) A curb provided with a series of glasses embedded and hermetically sealed within the top thereof, each of which is provided with a luminous background, substantially as and for the purpose set forth. (2) As a new article of manufacture, a curb having a series of glasses embedded therein and backed with a luminous material, substantially as described. (3) A curb provided with a detachable

355,810

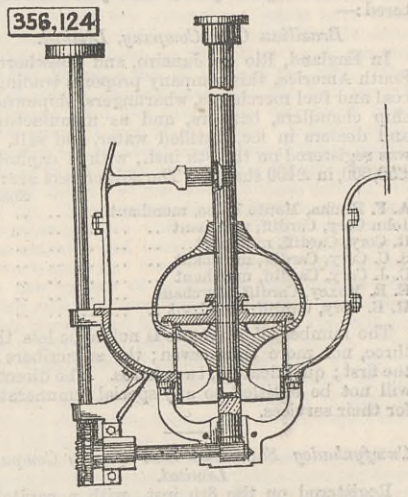


metal top in which are embedded and hermetically sealed a series of glasses, each provided with a self-luminous background, substantially as and for the purposes specified.

356,124. Turbine Water Wheel, *P. H. Holmes, Gardiner, Me.—Filed April 26th*, 1886.

Brief.—Vertically adjustable removable step and cam shaft for adjusting the same, both locked in position on the voke by a removable cap. Hollow shaft with

356,124

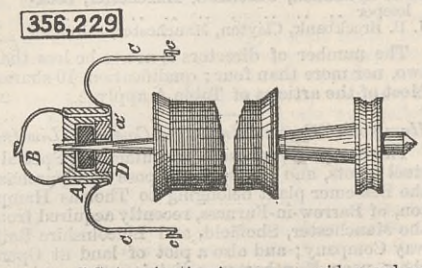


one opening in lower concave end and another slightly above the same, to permit constant flow of water to the step and through the shaft for cooling.

356,229. Flier for Spinning Machines, *L. E. Leigh, Northampton, Mass.—Filed June 5th*, 1886.

Claim.—(1) A flier for spinning frames, consisting of a cylindrical body with central perforation and a central chamber, a button in said chamber having a perforation slightly smaller than the perforation in the body of the flier, a wire guard B, having a central loop,

356,229

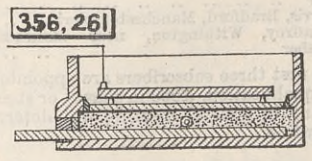


and arms C C, terminating in eyes *c c*, said guard and arms formed of a single wire, substantially as described. (2) The combination, with the spindle, of the flier-body A, having removable end *a*1, and the inclosed button D, which fits closely to the spindle, substantially as described.

356,261. Primary Voltaic Battery, *J. E. Pearce, Maidenhead, Berks, England.—Filed August 19th*, 1886.

Claim.—(1) A primary voltaic battery consisting of a vessel or jar, horizontal slabs of porous carbon and metal constituting the electrodes, a packing of granular carbon, a liquid solution of a compound of the metal electrode, and free chlorine gas circulating through the granular carbon during the entire working of the battery, substantially as herein set forth.

356,261



(2) A primary voltaic battery comprising a vessel or jar, the horizontal solid carbon electrode projecting through a liquid-tight joint in its vertical wall, the mass of granular carbon resting on said solid carbon electrode, the horizontal porous diaphragm or partition, the horizontal metal electrode arranged above said partition, a liquid solution of a compound of the metal electrode, and means for passing a gas through the mass of granular carbon, substantially as herein set forth.