PARALLEL SHAFT ROTARY ENGINES.

NOT very many rotary engines have been based upon a consideration of the mechanism employed to couple up two parallel shafts. The one taken for examination is a very ingenious specimen, and one which has obtained a good reputation.

The Parson's engine is similar in some respects to the common direct-acting engine, containing crank shaft and cylinder, but its mechanism so arranged as to dispense with the connecting-rod. For this piece is substituted a frame which contains the cylinders, and capable of revolving on suitable bearings.

When two wheels connect parallel shafts, one wheel placed inside the other and of one-half its diameter, an important geometrical fact exists which renders it possible to pair reciprocating pieces in the construction, and so fulfil one of the conditions of producing rotation by fluid pressure. This property is the familiar one that every point in the circumference of the small circle moves along a diameter of the larger one, thus describing straight lines relatively to the larger wheel and lines which pass through its centre. In Fig. 1, if the circle A with centre *a* turns inside the large circle C with centre *b*, the diameter of C being double that of A; such a point as at *b* in the circum-

FIG. 1

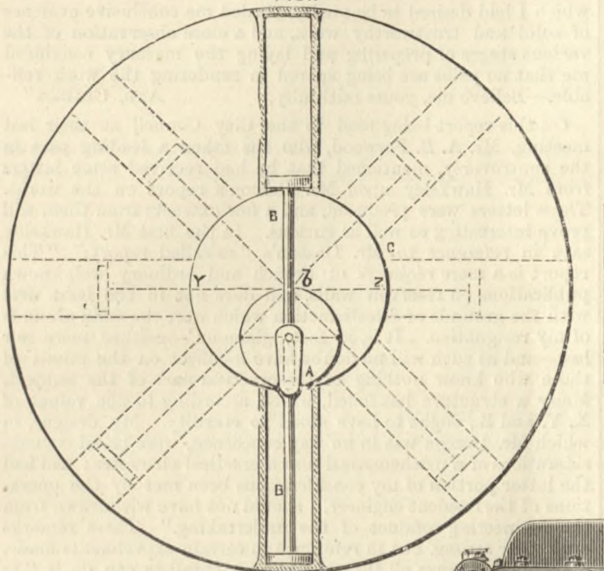
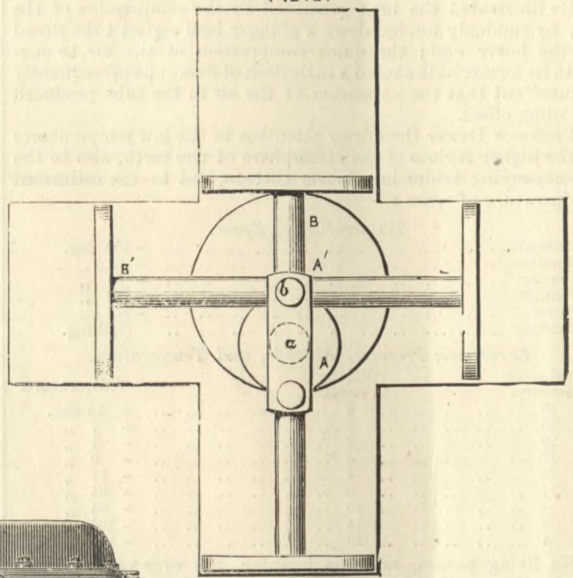
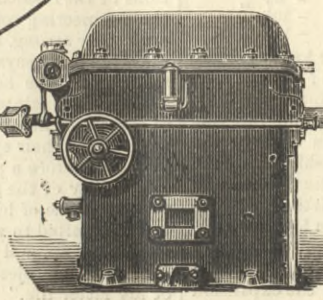


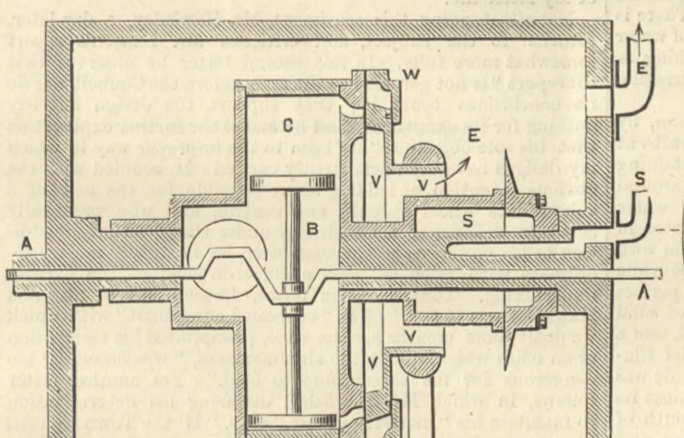
FIG. 2





GENERAL VIEW

FIG. 4



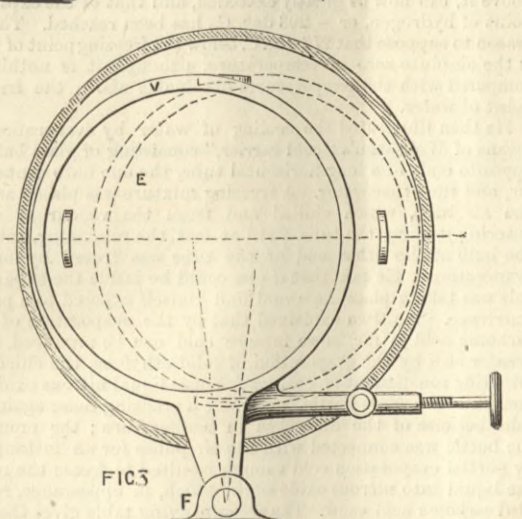


FIG. 3

ference of A will move along a diameter of C, the selected point *b* in the diameter Y Z.

This is embodied as shown in Fig. 1; a crank is formed from the axis of the inner circle and revolves about *a*; a large frame revolves about the centre *b*; both being steadied in suitable bearings. The frame and the crank are connected to each other by an intermediate piece B which has a piston at each end and pairs with cylinders placed radially and opposite in the large frame C, and securely fixed to it; the centre of the rod connecting these pistons pair with the crank pin of A. The effect of putting this mechanism in motion is to revolve both the frame and the shaft, the pistons sliding backwards and forwards in their respective chambers. That these pistons slide fairly in and out is a consequence of the before-mentioned geometrical property. They are evidently guided in a diameter of the frame, and in that particular diameter in which the crank pin of A moves. The positions of the parts of this mechanism that they take up when the crank has moved through a series of angles of 45 deg. are shown in the dotted outlines of Fig. 1. It will be observed that the shaft A is turned through a complete revolution, while the cylinder frame has turned through only one-half a revolution. A complete revolution of the frame is accompanied by two revolutions of the shaft.

Using this mechanism as a fluid-pressure engine, there have to be provided channels for admitting the fluid to expand the chambers at the proper time and for escaping upon the chambers contracting. We shall show presently that this is carried out by a very ingenious and valuable device.

If only one pair of these single-acting cylinders be used, dead points will occur when the pistons are at the end of their travel. To prevent the engine being affected by this, and to concentrate more power in the space, a second pair of cylinders is introduced similarly constructed to the others, but perpendicular to them. The particular point of the shaft-piece A, which will move along this new diameter, will be the end of a crank-pin situated in a crank equal in length to the other, but quite opposite, so that the two are in line with each other. The construction adopted, and a more proportionate size of cylinders is shown in Fig. 2; the lettering will sufficiently identify the parts.

A longtitudinal section—Fig. 3—of the engine is attached, showing all the essential parts. The centre of the cylinder frame C is hollow, and mounted on trunnions in rigid communication with the fixed frame D. The shaft A rests in bearings passing through the trunnions, which are also fixed to the frame D. Two cylinders are shown to the right in their vertical position, the piston piece B connecting the cylinder up with one crank-arm of A. The second pair of cylinders and its gear is placed alongside the others, and secured up to a second crank-arm which is immediately opposite to the other. The sketches will show the general character of the detail arrangements.

For the purpose of regulating the steam, cylinder ports are formed in the cylinder frame running from the outer end of each cylinder, and appearing in a flat surface at the side of the frame shown in Fig. 3. A large circular valve V is fitted in such a way that when its centre coincides with the centre of the cylinder piece, it completely covers the four ports, but if moved a little excentrically, something of the cylinder ports is outside the valve and something inside. This valve is so covered in that its outer periphery is always in contact with boiler steam, and its inner periphery with exhaust. In Fig. 3 is shown the section of a circular piece W, secured against the revolving frame, and amply overlapping the back of the valve to insure steam tightness. The space between this and the valve is filled with steam, which passes through channels situated in the cylinder frame between the cylinder ports, led by a pipe from the hollow space S about the trunnions. Steam rises into this space by passing through the hollow of the trunnions and through holes constructed as shown. The steam pipe from the boiler is fitted over the hole in the trunnions. For exhaust, the body of the valve is made hollow and opens out into the atmosphere, or, generally, into a tank or chamber D enclosing the whole engine. An exhaust pipe E carries the steam from the tank into the atmosphere.

The slide valve is attached to a piece jointed at a fulcrum F, Fig. 3. It is placed under control from the outside of the casing by means of the small wheel. The turning of this wheel, acting through proper connecting pieces, causes the valve to heel a little to the right or left. When the valve is placed over excentrically to the cylinder frame, the ports of the cylinders passing alternately beyond the outer periphery and into the interior receive steam and discharge steam as required to produce the movements of the pistons at the proper time. By varying the amount of excentricity the cut-off is correspondingly varied, the usual range in the larger engines being from one-eighth to seven-eighths. An excellent virtue of this excentric valve is that it is quite easy to reverse the engine without requiring any additional fittings. By turning the wheel so as to give it excentricity in the opposite direction, the effect is such as to reverse the disposition of the steam, and move the engine the other way. The valve is not rigidly fixed to the rocking excentric frame, but is capable of turning inside it, the frame forming a strap about the hollow boss of the valve, as shown in Fig. 3. The object of this is to cause the valve and cylinder surfaces to wear fair.

Besides the pistons of the main mechanism, which are easy to construct steam tight, the principal joints to be considered in this respect are those to make the valve tight in the steam chamber, and those in the construction necessary to conduct steam from the fixed trunnions into the moving gear. Provision is made for the valve by introducing a balance ring at its back, which is kept in rubbing contact with the enclosing piece by the pressure of steam. Steam is prevented from escaping from the enclosure about the fixed trunnions into the outside tank by means of the pressure of a kind of spring buffer attached to the end of the revolving frame against the fixed frame.

A very complete system of lubrication is adopted. Channels or oilways are constructed through the body of the machine leading to the principal rubbing surfaces; a force pump worked by the engine itself draws the oil from the base of the tank and sends it through all the channels well into the joints. The oil, when it has circulated through the gear, passes out with the exhaust steam and falls again into the bottom of the tank. A special device is used to prevent the water of condensation, which will fall with the oil into the tank, from collecting and being drawn by the lubricating pump.

One great feature in this engine is the reduction of the number of strokes of the piston as compared with the revolutions of the shaft. As before pointed out, one half turn of the revolving cylinder frame, that is, one stroke of the piston, produces a complete turn of the shaft; in ordinary reciprocating engines two strokes would of course occur per revolution of the shaft. For engines running at high speeds this is an unquestionable advantage. The parts being also well balanced, as far as regards the weights of the pieces, the engine when running runs very smoothly, and makes very little noise. For a high speed engine this has a fair reputation for economy, a consequence of adopting a certain amount of expansion. Since its introduction other high speed engines have been carefully treated in their valve gear for the purpose of employing steam expansively, and as a consequence it is being hard pressed in this direction by its rivals. The smaller sizes attain a very high speed, those with 3¾in. cylinders and 3in. stroke making 1500 revolutions per minute.

A very neat and effective mode of connecting up revolving parallel shafts that are a little out of line is the Oldham coupling, and it is surprising that this arrangement has not fathered rotary engines to the same extent as has the Hooke joint. The connection is peculiarly favourable to efficient jointing, the intermediate block having a rectilinear reciprocation, and, therefore, capable of being embodied by an ordinary cylinder and piston. It is also to be recommended because that the two shafts move with equal angular velocities, a feature not possessed by the two shafts in the Hooke joint. R.

HOW TO DEAL WITH THE SNOW.

THE condition of the London streets during the past few days or weeks, is calculated to make one wonder whether our belief in our material progress had not been a dream rudely dispelled by the unpleasant and palpable reality of a snowstorm.

London by night, London by day, London in the fog, and London in the rain, are all aspects of the great metropolis known to its students, and they are more or less supportable, but London under a nasty dirty cover of grey mud, which is a mass of slush one minute and a collection of slippery rocks the next, is almost a new experience, and not very supportable. It is very curious that we hear of little trouble with the snow in other countries. In Paris it has been carted away with a praiseworthy celerity which the Paris correspondent of the *Times*, with an infantile simplicity cloaking the bitterest irony, says is not far behind the efficiency of our own metropolis. In Vienna also the snow has been got rid of quickly. At both capitals the same system appears to have been used. Salt was strewed on the snow, which was then swept into carts before it had time to freeze again.

But the wholesale removal and cartage of the snow of so large a town as London presents difficulties which are probably insurmountable, else why should our local authorities always have failed in it? It is, however, questionable whether the rapid removal of snow be really a very desirable object. In Russia where the snow may be counted with as a constant companion for nearly five months in the year, the contrary opinion is entertained. There the arrival of snow is hailed with delight, its presence made the most of, and its disadvantages counteracted as well as possible. Our own experience during the last few days would seem to point in the same direction. Slippery snow is bad enough, but when horses are rough shod, as they should be, or goloshed, they can get some footing on it, but none on a hard slippery frozen roadway without any relief but an occasional sheet of ice. In Russia everything is done to convert the fallen snow as rapidly as possible into a good hard and even road. Water is thrown over it in parts where it seems loose and rotten. It is pressed down with wooden shovels, and then tracks are cut in it, which consist of parallel grooves running transversely to the road, and affording the horses a good foothold. Over this sand is thrown, which has the effect of reducing materially the slipperiness of the road. The snow is kept as clear from the footpath as possible, and shovelled into the roadway. All horses are rough-shod by order. Salt is not only never used, but its employment is forbidden, as it has the very dangerous quality of rendering the snow more slippery the moment it freezes again.

During the recent snowfall in London no attempt was made to employ rotary sweeping machines; yet this effect on the snow would be highly beneficial. The wire brushes would tend to disintegrate the rough clumps of snow and reduce them to a fine powder, which could be easily dealt with. All attempts at thawing the snow are to be discouraged and are fraught with danger, for in our changeable climate, supposing a successful method had been discovered, it is quite possible that a sharp frost following a few hours after a rapid thaw would make our roads even more impassable than they are at present. In all cases when snow falls sand should be thrown in the roadway after it has been swept to reduce the slipperiness of the snow in case of succeeding frost. Gravel is of little use, and frequently makes the road more dangerous than before. Wayfarers of uncertain gait skate cautiously along, until suddenly getting their feet on a gravel pebble, roll down helplessly.

We cannot see why the principle of the rotary brush or of the American snow plough should not be adopted for our streets. It is quite clear that the vestries cannot be relied on for clearing away the snow by means of scavengers—indeed, to organise, on the spur of the moment, efficient gangs of street cleansers in every district is practically impossible. But we think that a traction engine or steam road roller, fitted with a snow plough in front of it and sand distributor behind it, would be found very efficient. At Hampstead the vestry sent their steam road rollers over the roads, but omitted to strew sand. The consequences, we are assured, were disastrous.

The apathy of the London vestries is indeed a disgrace. In most parts of London no action has been taken at all; the snow has simply been allowed to lie. In the Strand, at the corner of Wellington-street—in which thoroughfare the Lyceum Theatre is situated, and which leads to Covent-garden and Drury-lane theatres—a large mountain of snow was suffered to remain untouched for days. Owing to the exigencies of traffic all vehicles driving eastwards from Charing-cross and turning up Wellington-street had to plunge into this mountain and struggle through it as best they might. Carriages containing ladies dressed in ball toilet, rocking about on this rubbish heap, gave a sorry spectacle.

A wonderful contrast is shown by the Metropolitan Board of Works in the Embankment Gardens, where a kind of wooden snow plough was used, and a comfortable foot-path maintained even on the first day of the snow-fall. Traction engines and road rollers fitted with snow ploughs in front and sand distributors behind, might be put into service on these occasions to place the snow along the sides of the streets ready for removal by scavenging wagons and carts, as soon as scavenging gangs can be organised. This would make no difference in the obstruction felt by shopkeepers, would free the street, and would shorten the work of clearance on such an occasion as that of the past week, by days.

THE ROYAL INSTITUTION.

GASES IN METEORITES.

ON Tuesday, January 5th, at the fourth of his series of six lectures on "The Story of a Meteorite," Professor Dewar began by speaking of the large proportion of magnesia in meteorites, and showing experiments to prove that earthy mixtures containing that substance have a tendency, after being moistened, to set rapidly into hard masses of the nature of solid stone. In the interior of meteorites stony crystals are heterogeneously cemented together, and he pointed out that a method of readily ascertaining, to some extent, the nature of these crystals is to take a thin transparent or translucent slice of meteorite and to examine it by polarised light; the crystals are then differentiated by the colours or markings they exhibit. The bottoms of two common glass tumblers, apparently just alike, and purchased at the same time, at the same shop, were placed in polarised light, and images of them projected on the screen; one then still appeared perfectly transparent, but the other had dark markings, due, the speaker explained, to the glass being under conditions of stress and strain, because of imperfect annealing. He showed that certain gems contain air-spaces, sometimes partly filled with liquid, sections of certain topazes presenting this phenomenon; the heat of the electric lamp in some cases volatilised the liquid within the spaces; the liquid, he said, was carbonic acid under pressure. The topaz, he stated, is silicate of alumina. In meteorites no such liquid is found, but air-spaces occur in the crystals, and these spaces appear to have been once filled. Meteorites contain gas, which is practically coal-gas in another form, and it can be extracted from them by means of heat and the Sprengel pump; such gas is also ejected from volcanoes. The late Professor Graham, of the Royal Mint, was the first to extract gas from meteorites, and the fact was illustrated by the lecturer, who extracted some of the gas from a powdered fragment of the Indian meteorite. Some metals, he said, occlude and evolve gases with much facility; palladium, for instance, will absorb a considerable quantity of hydrogen, give it out again with heat in a mercurial vacuum, and absorb the gas once more as it cools. Silver, he said, absorbs oxygen at high temperatures, and the peculiarity of the phenomenon is, that silver absorbs the gas at temperatures which cause other metals to give it out. As the silver cools, the metal gives it out from little craters which form upon its surface; he illustrated this by experiment, and caused the gas issuing from the little craters to make the end of a smouldering taper burst into flame several times in succession.

Pumice, the lecturer stated, is merely volcanic glass or lava blown into froth, and large portions of stony meteorites consist virtually of glass. Pumice floats on water, not because it is lighter than water, but because it is so full of bubbles, and, in great volcanic eruptions the sea is sometimes covered for miles with pumice several yards thick, so that ships can hardly get through the floating masses. He caused some lumps of pumice to rise and sink alternately in water, by varying the pressure of the air above the surface of the water. On the sea the pieces rub against each other, until finally they sink, and cover much of the ocean bed with fine volcanic dust, which can be raised by dredging, and when fused it forms a dark kind of glass resembling common bottle glass. The most potent agent for ejecting materials from volcanic craters, is high-temperature steam.

He called attention to the following table relating to the gases found in meteorites:—

Gases of Meteorites.

	Iron Meteorites.		Stony Meteorites.	
	Texas.	Auguste.	Pultusk.	Parnallee.
Carbonic acid	8·59	9·75	60·29	81·02
Carbonic Oxide	14·62	38·33	4·35	1·74
Hydrogen	76·79	35·83	29·50	13·59
Nitrogen	—	16·09	2·26	1·57
Marsh gas	—	—	3·61	2·08

THE TEMPERATURE OF AIR AT HIGH ALTITUDES, AND OF STELLAR SPACE.

In his fifth lecture on meteorites, delivered on Thursday January 7th, Professor Dewar said that Captain Noble had sent him from Sir William Armstrong's works a large block of steel, in the centre of which he had fired off some gunpowder, and imprisoned the resulting gases, without bursting the block; he would open the vessel after the lecture, and let out the gases then, rather than at the beginning of the discourse, because the gases had an unpleasant smell. The pressure of the gases, he said, was then not so powerful as directly after firing the gunpowder, because at that time they were greatly heated, but had since had time to cool down. It formed a large illustration of how gases might get into crystals formed at a low temperature. He also exhibited a block of malleable iron, originally about a foot square, but subsequently broken into four tolerably uniform rectangular pieces by the firing of nitro-glycerine which had been poured down a small hole in the centre of the original block. He pointed out the crystalline structure of the ruptured iron.

The lecturer next spoke of the heat generated by the pressure of the air against a meteorite traversing the upper regions of the atmosphere, and called attention to the following table:—

Effects of Pressure on Air.

Pressure in atmospheres.	Elevation of temperatures.	Pressure in atmospheres.	Lowering of temperatures.
2	95	$\frac{1}{2}$	71
4	221	$\frac{1}{4}$	125
8	389	$\frac{1}{8}$	166
16	612	$\frac{1}{16}$	196
32	911	$\frac{1}{32}$	219

He illustrated the heat generated by the compression of the air, by suddenly forcing down a plunger into a glass tube closed at the lower end; the quick compression of the air to one-sixth its former bulk caused a little flash of flame; he subsequently pointed out that the expansion of the air in the tube produced a cooling effect.

Professor Dewar then drew attention to the low temperatures of the higher regions of the atmosphere of the earth, also to the accompanying tables in relation thereto, and to the estimated temperature of space:—

Temperature of Space.

Herschel	–150 deg.
Hopkins	– 38·5 ,,
Fourier	– 50 ,,
Pouillet	–142 ,,
Pictet	–274 ,,
Rankine	Nothing.

Barometric Pressure, Altitude, and Temperature.

Inches of mercury.	Altitude in miles.	Temperature.
30	0	+ 15 deg.
25	1	+ 7 ,,
20	2	– 1 ,,
17	3	– 9 ,,
14	4	– 17 ,,
11	5	– 25 ,,
4	10	– 65 ,,
2	15	– 105 ,,
1	20	– 145 ,,

No living person, said the lecturer, has ever yet reached a height of five miles above the surface of the earth; someday, he said, people will no doubt be able to rise ten miles above its surface, but not without protection from the cold, and carrying up their necessary supply of air. It is certain that in the region traversed by the meteors so often seen flashing through the air by night, the temperature must be exceedingly cold and the atmosphere exceptionally rare. By modern methods exceedingly low temperatures can be produced; the once low temperature of 100 deg. C. below the freezing point of water, or as many degrees below the freezing point as that of boiling water is above it, can now be greatly exceeded, and that of the expansion point of hydrogen, or – 203 deg. C., has been reached. There is reason to suppose that 273 deg. C. below the freezing point of water is the absolute zero of temperature, although it is nothing as compared with the temperatures obtainable above the freezing point of water.

He then illustrated the cooling of water by evaporation, by means of Wollaston's "cold carrier," consisting of glass bulbs at opposite ends of a long horizontal tube, the one bulb containing air, and the other water. A freezing mixture was placed around the air bulb, which chilled and froze the vapour of water entering it along the tube, until at last the remaining water in the bulb at the other end of the tube was frozen by its own evaporation. He said that if one could be inside the tube while this was taking place, he would find himself exposed to a perfect hurricane. He then explained that by the evaporation of solid carbonic acid a far more intense cold can be produced, and a greater still by the evaporation of solid ethylene, the chief illuminating constituent of coal-gas. Some liquid nitrous oxide was poured into a glass bottle, and made a cracking noise against its sides because of the difference in temperature; the mouth of the bottle was connected with the air-pump for an instant, and by partial evaporation cold enough resulted to freeze the rest of the liquid into nitrous oxide snow, which, in appearance, resembled carbonic acid snow. The accompanying table gives the temperatures at which various liquefied gases boil:—

Boiling Points, below the Freezing Point of Water.

	Boiling point below freezing point of water. Deg. C.	Boiling point 5 to 10 mm. pressure. Deg. C.
Carbonic acid	– 80	–116
Nitrous oxide	– 90	–125
Ethylene	–103	–142
Oxygen	–184	–211
Nitrogen	–193 1	–225 solid
Air	–192·2	–207 solid
Carbonic acid	–193	–211
Nitric oxide	–153	–176
Marsh gas	–164	–201 solid

The highest of ordinary clouds, he said, never reaches an altitude of more than five miles; at four and a-half miles clouds cease to be liquid water, and at higher elevations must consist of particles of ice. The lower rain clouds are but one mile high.

Height of Clouds.

	Miles.
Cirrus	4½
Cirro-Cumulus	4
Alto-Cumulus	2½
False-Cirrus	2
Cumulus	1

Professor Dewar then exhibited some radiometers and vacuum tubes lent to him by Mr. William Crookes, remarking that solids in high vacua have great mobility, and that a very rare atmosphere favours electrical discharges, consequently at high elevations material conditions obtain with which we are not generally familiar in the lower regions of the atmosphere of the earth.

To show that low temperatures can be accurately measured, he said that he would prove that his thermometer was trustworthy. It consisted of a thermo-electric couple of copper and iron, connected with a reflecting galvanometer, and by the evaporation of solid carbonic acid he produced a temperature of about 100 deg. C below freezing point. The lowest temperature ever obtained by Faraday was, he said—115 deg. C. He pointed out how accurately the thermometer indicated the various temperatures; after which, by the use of ethylene, he liquefied common air; he also caused liquid air to evaporate by taking off the pressure in the tube. These phenomena were visible to all present by means of magnified images thrown upon the screen by the aid of the electric light.

MR. HAWKSLEY AND THE VYRNWY WORKS QUARREL.

SINCE we last referred to the strange and unfortunate difficulties and disputes in reference to the construction of the new waterworks for Liverpool at Vyrnwy, some remarkable letters between Mr. Hawksley, C.E., and a member of the Liverpool Corporation have been made known. Sir Andrew Clarke has also presented a report upon the works, to the following effect:

"Whitehall, S.W., January 5th, 1886.

"Dear Sir,—I completed yesterday my examination of the Vyrnwy Works, and in anticipation of the fuller expressions of opinion, which I will send to the Town Clerk, I think you may wish to know at once that I see no reason to doubt the design being worthy in all respects of Mr. Hawksley's reputation, and I am fully satisfied that its execution is being well and skilfully conducted.

"The trial shaft and openings into the heart of the dam which I had desired to be made, afforded me conclusive evidence of solid and trustworthy work, and a close observation of the various stages of preparing and laying the masonry convinced me that no pains are being spared in rendering the work reliable.—Believe me, yours faithfully, AND. CLARKE."

On this report being read to the City Council at their last meeting, Mr. A. B. Forwood, who has taken a leading part in the controversy, mentioned that he had received some letters from Mr. Hawksley upon Mr. Deacon's report on the works. These letters were produced, and a few extracts from them will prove interesting as well as curious. In the first Mr. Hawksley says in reference to Mr. Deacon's "so-called report:" "This report is a mere *réchauffé* of French and ordinary well-known publications on reservoir walls, and does not in the least deal with the grounds of dissatisfaction which were the main grounds of my resignation. It is, in fact, 'glamour'—neither more nor less—and as such will no doubt have its effect on the minds of those who know nothing of the practical part of the subject. Many a structure has failed, which, according to the values of X. Y. and Z., ought to have stood to eternity. My designs, in which Mr. Deacon was in no way concerned, were based on considerations of a mathematical *plus* a practical character; and had the latter portion of my considerations been met by the operations of the resident engineer, I should not have withdrawn from the engineering conduct of the undertaking." These remarks are rather strong, but in reference to certain experiments made, Mr. Hawksley says all that the experimentalists can do is "to stethoscope the heart of a corpse," and asks how they can "become acquainted with the interior construction and action of materials placed 20ft., 30ft., 50ft., beneath the surfaces they have under their eyes' regard." Intimating his preparedness to discuss "before a proper tribunal" the question of the strength or stability of the reservoir wall if necessary, he explains that the real cause of his expressed disgust in this matter has been mainly limited to what he deemed the improper character of the workmanship, and finally expresses the hope that he has "now done with a subject matter which has embittered many a day of my latter life."

Notwithstanding this sentiment, Mr. Hawksley, a day later, returns to the subject, and criticises Mr. Deacon's report somewhat more fully. In this second letter he observes that the report "is not germane to the topic before the Council, nor do its conclusions touch it; they support the design but say nothing for its execution;" and he makes the further explanation that his sole objection "has been to the improper way in which my designs have been persistently carried out, coupled with the obvious intention of holding me responsible for the acts of a subordinate whom I could not control, and who practically acted in defiance of my authority under the plea that, in addition to his powers as resident engineer, he had other powers coordinate with mine as joint engineer-in-chief of the Vyrnwy undertaking. Thus, in plain terms, Deacon was to play and Hawksley was to pay." The "concealed agreement" with which we dealt some months ago, he adds, precipitated his resignation of an office which, under the circumstances, "was becoming too dangerous for me to continue to hold." Yet another letter follows, in which Mr. Hawksley, declaring his determination to maintain his "masterly silence," says, "If the Town Council likes to appoint the individual who has brought all this trouble upon it, that is no affair of mine, and if it chooses to pull its dam-wall to pieces in search of a justification for such an appointment, that is its own affair, however disappointing may be the ultimate result." And then comes a fourth letter, advising Mr. Forwood that it is not worth his while to do anything further in regard to this affair, and generally expressing himself weary of the matter. Here, for the present, at all events, this extraordinary business rests; but a good deal more is likely to be heard of it, and meanwhile the importance of hastening the new works to completion is becoming daily more evident.

TENDERS.

TENDERS for constructing a 3ft. 6in. by 2ft. 4in. sewer from high road along Lordship-lane to Jolly Butchers'-hill, Wood-green. Mr. W. A. H. de Pape, engineer.

	£	s.	d.
J. Edmondson, Lower Edmonton	10,040	1	3
W. Cunliffe, Barking	11,544	0	0
G. Bell, Tottenham Wharf	10,410	3	6
C. Killingback, Camden Town	10,495	0	0
J. Pizzey, Hornsey	13,300	0	0
L. Bottom, Battersea, London	15,644	0	0
J. W. and J. Neave, Leytonstone, E.	11,664	10	3
Wilkinson Brothers, Finsbury Park, N.	9,967	0	0
G. Neal, Wandsworth-common	10,168	0	0
John Oliver, 86, Coldharbour-lane	11,125	0	0
C. Dickinson, Loughborough Junction	11,336	12	9
W. Nicholls, Wood-green, N.	11,879	0	0
J. Bloomfield, Tottenham	8,164	18	8
B. Cooke and Co., Battersea	10,978	0	0
Thomas Adams, Moorgate-street	9,295	10	10
Engineer's estimate	10,152	0	0

ABINGDON TOWN COUNCIL.—At a recent special meeting of the Council, the Market Committee resolved to accept the tender of Wilkes' Patent Metallic Paving Company for paving the new Cattle Market.

RAILWAY MATTERS.

THE erection of the ironwork portion of the new Exchange station for the Lancashire and Yorkshire Railway at Liverpool is proceeding with rapidity in the hands of Messrs. Simpson and Wood, of James Bridge. The work has been going on for something like twelve months, and it is anticipated that about the close of March the whole of the 2000 tons of ironwork will have been fixed.

A MOVEMENT unfavourable to the employment of steam on tram lines has made its appearance among certain of the residents of Birmingham. For some time past complaints have been made of the nuisance said to be caused in certain localities by the blowing-off of steam and smoke from the engines, and the ratepayers of Broad-street are strenuously opposing the scheme now before the Council for laying steam tram lines along to Edgbaston.

THE dispute between the New York Elevated Railroad Company and its drivers and stokers has been settled. The managers of the railway have conceded all the demands of the drivers and stokers excepting that for the eight hours' system. On this point a compromise has been made by the agreement that nine hours shall be the length of a day's work, instead of eleven and twelve as heretofore. The day's wages are to be—for drivers, from 3 dols. to 3 dols. 50c., according to the length of service, and for stokers, from 1 dol. 75c. to 2 dols.

IN a report on an accident which occurred on the 8th December at Dalkeith station on the North British Railway, Major Marindin concludes:—"I would strongly recommend the company to take warning from this slight accident, and to lose no time in re-arranging and re-signalling this station, which affords miserable accommodation to the public, and which is unsafe in its present condition." As to accommodation, there are many, as for instance, on the line from Fenchurch-street to the Docks, which afford none at all. Perhaps this is what Major Marindin meant of Dalkeith.

THE Severn Tunnel was practically opened for goods traffic on Saturday, and the first coal train run was from Nixon's, and from Thomas and Co. The coal was cut at Aberdare Saturday morning, 140 tons in quantity, and at night was at Southampton! If a mail steamer had been waiting, this could have been put into her bunkers before midnight. The first coal train had an influential convoy of the leading officials of the Great Western, Mr. Walker, the successful contractor, and others. Its importance is of the first order, and must have a great effect on shipping, and also upon certain railways. The distance from Bristol, the great road to the south-west of England, is, by way of Gloucester, 93 miles to Cardiff and 82 miles to Newport. This tunnel will now make the distance 39 and 26 miles respectively.

THE London Streets Tramway Company and the London, Highgate, and Finchley Tramways Company are each seeking powers to run, the former company from the Archway Tavern along the Archway-road to Finchley, and the latter from the Archway Tavern through the Archway-road right on to the northern boundary of Finchley. The Finchley and Hornsey Local Boards and the Islington Vestry have all decided to oppose the scheme of the Highgate and Finchley Company. The scheme of the London Streets Company does not affect Finchley, but Hornsey and Islington have agreed to oppose their scheme, unless a clause is inserted in the Bill for the widening of Highgate Archway at the company's expense, and the Hornsey Board have resolved that it must be widened so as to give a roadway underneath 44ft. wide The arch now only admits of a road 16ft. 6in. wide.

THERE is only a difference in degree between the petty tricks resorted to by some small tradesmen and that of a railway company whose officers are instructed not to inform the public when its line is blocked. Traffic on the District Railway was interrupted on Monday, at the busiest hour of the morning, by the breaking down of an engine on the up line. The engine being the property of another company, with running powers, the District Company was not culpated, but great inconvenience was inflicted upon passengers by the District Railway, for which the District Company and its officers are liable. Railway passengers often have the option of different routes. If one, for any reason, be to their knowledge blocked, they can take another. If, however, the servants of a company tell nothing and pretend to know nothing, with a view to holding the customer as long as possible, they adopt a mean trick, and, playing upon the credulous expectation of the would-be passengers, do infinitely more harm in the long run than they would by telling the truth at once and allowing passengers to go away with as little loss of time as possible.

THE members of the Congo Railway Syndicate met on the 5th inst. at the Manchester Chamber of Commerce, Lord Egerton of Tatton presiding. Mr. J. F. Hutton, M.P., gave a detailed report of the negotiations which had been carried on in Brussels with the Ministers of his Majesty the Sovereign of the Congo State, and submitted a copy of the agreement which had been signed by General Strauch, Minister of the Interior, M. Van Eckveld, Minister of Foreign Affairs, and M. Van Neuss, Minister of Finance, on behalf of the King; and by Messrs. W. Mackinnon, H. M. Stanley, and J. F. Hutton on behalf of the company. The company is to be founded by royal charter, and it is proposed to call it "The Royal Congo State Railway and Navigation Company." The Congo Government will grant the company all the lands for the railway, stations, &c., and in addition 10,000 acres of land and all minerals for every mile of railway constructed. Certain privileges and concessions relative to the Customs duties, freedom from taxes, and guarantees of traffic are also to be granted to the company. Another meeting will take place on the 20th.

A HEAVY landslip occurred on the London and North-Western Railway on Saturday morning near the entrance of the Christleton Tunnel, south of Chester Station. It was found out by a goods train much in the same way as an Irish pilot is said to have found out the rocks, namely, by running on them. The tunnel carries the line under the Shropshire Union Canal, and at either end there is a deep bank, partly faced with brickwork. Part of this was carried away, whether from percolation of water from the canal into the bank or from the disintegrating action of the severe frost, or from both causes combined, is not apparent, but an immense mass of material, carrying the brick facing with it, fell directly across the railway, blocking both lines. The down Irish mail passed the spot between two and three o'clock a.m., and the line was then safe. Shortly after five o'clock, the Rugby goods train for Chester, travelling at thirty miles an hour, emerged from the tunnel and dashed into the *debris*. The engine plunged forward some twenty yards into the soft material, then stopped with a terrible jolt, and fell over, pitching and piling the forty wagons, a considerable proportion of which remained in the darkness of the tunnel, into a confused and wrecked mass. The driver and firemen had remarkably narrow escapes. The brakesman, who was travelling in the rear van, and who received a severe shaking, could not in the darkness of the tunnel tell what had happened in the forepart of the train. He at once threaded his way through the tunnel, and saw that the driver and fireman had escaped unhurt. The empty wagons close to the engine escaped without injury. It was in the middle of the train where the heavily laden wagons were that the real damage was done and the full force of the violent stoppage felt. A dividing brick wall runs between the two lines in the tunnel, and by this means the portions of wreckage were kept from being strewn beyond the down line. The telegraph wires are also situated on the free side of the railway. The danger of the canal bursting its weakened bank and flooding the railway has made the draining of the canal necessary. The portion of the canal between Greenfield Locks and Christleton Locks, not half a mile long, embraces the scene of the landslip, and this section was speedily drained off at the Greenfield Locks, but is now open again for traffic.

NOTES AND MEMORANDA.

IT is stated that trials made of Natal coal on the local railway have ended satisfactorily.

THE deep boring which has been sunk at the Dover Guard Prison for a water supply close to the sea, has now reached a depth of 1000ft., being 700ft. below the sea-level.

FROM the 13th inst., the Russian New Year's Day, the Russian Mint will coin ten-rouble gold pieces, which, like the silver coins of full weight, will be composed of 900 parts pure metal and 100 parts copper.

IN 1870, when the make of gas in Glasgow was 1,295,863,000 cubic feet, and the sale 1,026,324,000 cubic feet, the leakage was 20·8 per cent. During the year ending 1884-5 the make was 2,368,131,000 cubic feet, the sale 2,115,804,000 cubic feet, the percentage of leakage reduced to 10·6. The income from the sale of gas in 1870 was £210,736, when the rate was 4s. 7d. per thousand, and during the last year it was £364,203, at a rate of 3s. 6d. per thousand. In 1870 the candle-power was 28·2, and last year it was 26·3.

FROM statistics just published it appears that the production of all descriptions of steel in the United States since 1874 has been as follows:—1874, 241,614 net tons; 1875, 436,575 tons; 1876, 597,174 tons; 1877, 637,972 tons; 1878, 819,814 tons; 1879, 1,047,586 tons; 1880, 1,397,015 tons; 1881, 1,778,912 tons; 1882, 1,945,095 tons; 1883, 1,874,359 tons; 1884, 1,736,985. The principal steel manufacturing State of the Union is Pennsylvania, which, of the 1,736,985 tons of steel made last year, produced 1,157,376 tons.

MESSRS. RYLAND'S blast furnace returns to December 31st, 1885, give the furnaces in different counties of England as follows:—Cumberland, 53; Derbyshire, 53; Durham, 46; Gloucestershire, 8; Leicestershire, 2; Lincolnshire, 21; Lancashire, 49; Northamptonshire, 29; Northumberland, 7; Nottinghamshire, 2; Staffordshire, North, 40; Staffordshire, South, 113; Shropshire, 19; Somersetshire, 1; Wiltshire, 6; Yorkshire, West Riding, 42; Yorkshire, North Riding 103—a total of 594 furnaces, of which 289 are in blast. In Wales there are: North, 10; South, 138; and in Scotland, 143—making up a total of 885 furnaces, of which 421 are in blast.

A NEWSPAPER correspondent describing the American watch manufactory at Waltham, Mass., and in speaking of the astonishing minuteness of some very essential parts of the watch, says:—"A small heap of grain was shown to us, looking like iron filings or grains of pepper from a pepper castor—apparently the mere dust of the machine which turned them out—and these when examined with a microscope were seen to be perfect screws, each to be driven to its place with a screw-driver. It is one of the statistics at Waltham worth remembering that a single pound of steel, costing but 50 cents, is thus manufactured into 100,000 screws, which are worth 11 dols."

ACCORDING to the recent statistics there are in Austria 1623 newspapers and periodicals, of which 490 are political, 175 economical, 118 agricultural, 113 connected with trades or special occupations, 92 medical or scientific, 98 pedagogical, 55 geographical and historical, 208 representing literature and humour, 13 military, 129 advertising papers, 53 ecclesiastical, and 107 local papers; 727 of the whole number are published in the single province of Lower Austria. As to language, 1054 are German, 225 Czech, 108 Polish, 95 Italian, 35 Slavonian, 32 in other Slav dialects, and 74 are mixed—that is, have portions in different languages. It is noteworthy that, as compared with the preceding year, the German papers have increased in number by 7 per cent., the Italian by 6·7, the Czech by 13·6, the Slavonian by 20·7, and the Polish by 5½.

THREE tall chimneys belonging to Kunheim and Co., of Berlin, were lately destroyed by means of gun-cotton. The largest was about 147ft. high, and 10ft. diameter at the base. In order that it should fall outwards from the city, the charge of gun-cotton—about 57 lb.—was attached in portions to the side next the city, and to the adjacent sides. All three were exploded simultaneously with a magneto-electric apparatus. The chimney, instead of falling obliquely, collapsed vertically, and on inspection the four walls of the pedestal were found to have been driven outwards. The bricks were all detached from each other, and nearly all entire. *Nature* says the *débris* was thrown a very little distance. The two other chimneys, treated similarly, fell as was expected, *i.e.*, obliquely away from the city. One of them, in falling, broke in two about the middle.

IN preparing a plan for an electric lighthouse or tower 1000ft. in height for lighting Paris, M. Bourdais, the architect of the Palace of the Trocadero, Paris, investigated the height to which a column of different materials could be raised without crushing under its own weight. The weight of a pyramid with a square base may be expressed by the equation $P = D^2 \frac{h}{3} \delta$, in which D represents the side of the base of the pyramid, h the height, and δ the density. The resistance is $R = \frac{P}{D^2}$; hence $R = \frac{1}{3} h \delta, h = \frac{3R}{\delta}$. If the limiting value of R is taken at one-sixth of the load, which produces crushing in iron, and one-twentieth for different varieties of stone, the following table may be deduced:—

Material.	R.	δ.	h.
Porphyry	2,470,000	2870	2550 metres.
Iron	6,000,000	7800	2280 ,,
Granite..	800,000	2700	900 ,,

THE New York Commercial Agency has prepared some tables with regard to the condition of the workmen out of employment in 21 of the States, and from these it appears that while in 1880 the number of workmen employed in the different factories, &c., was 2,450,479, it is now 350,000 less, despite the great increase which has since taken place in the population of the country. The agency has received replies to its inquiries from 272 cotton factories, of which 36 are closed, and from 187 woollen factories, of which 55 are now closed. The woollen factories of New England have discharged 21,000 workmen, and in Lowell county, Massachusetts, there are 2300 fewer workmen employed than in 1884. In the textile industry most manufactories are only working three-quarter time, and in the State of New York alone there are 14,000 hands out of employment. Wages have fallen 20 and even 25 per cent., and, according to a circular of the Fall River, Massachusetts, weavers, the price for a piece of cloth 25 yards long, which was 30c. in 1873, is now only 18c. In Canada, out of 1417 manufactories in the province of Ontario, 72 are either closed or working short time, and 3089 workmen have been discharged, while 2470 are working half-time. In the province of Quebec wages in the wool and cotton factories have fallen 10 per cent.

MR. A. H. HAIG has described, at a meeting of the Engineers' Club, of Philadelphia, the following process for making photographic copies of drawings in blue line on white background, invented by H. Pellet. A bath is first prepared consisting of ten parts perchloride of iron, five parts oxalic or some other vegetable acid, and 100 parts water. Should the paper to be used not be sufficiently sized, dextrine, gelatine, isinglass or some similar substance must be added to the solution. The paper is sensitised by dipping in this solution and then dried in the dark, and may be kept for some length of time. To take a copy of a drawing made on cloth or transparent paper, it is laid—not in daylight—on a sheet of the sensitive paper and then exposed to daylight in a printing frame or under a sheet of glass. The length of exposure varies with the state of the weather from fifteen to from forty to seventy seconds in winter. The print is immersed in a bath consisting of fifteen to eighteen parts of prussiate of potash per 100 parts of water. Next when the image is obtained it is freely washed in water and then passed through a bath consisting of eight to ten parts of hydrochloric acid to 100 parts of water, for the purpose of removing protoxide of iron salt. It is now again washed well in clean water and finally dried, when the drawing will appear in blue on a white background.

MISCELLANEA.

THE electric lighting of the French Opera House is almost complete with 3000 incandescent lights.

THE Wolverhampton Chamber of Commerce has just received specifications and patterns for a further supply of hardwares, mainly tinned iron goods, which are required by the War-office.

AT the competitive trial of armour that has just taken place at Bucharest, we hear that the Grüson chilled iron cupola has stood much better than the German steel-faced armour. We hope to have details shortly.

AT the last meeting of the Metropolitan Board attention was drawn to the serious danger which had arisen in London from the derangement of the fire alarms by the late snowstorm. A fire had occurred in Lambeth, and there had been much delay in obtaining the assistance of the brigade owing to the breaking down of the alarm communications.

THE ironworkers at some of the South Staffordshire mills are expressing much dissatisfaction at having to accept a reduction in wages. At several establishments they have intimated that, although at present they continue at work, they are not yet determined whether they shall resume at the drop next week. It is not believed, however, that there will be much trouble with them.

AT a meeting of ironworkers held at Walsall on Monday, the award was harshly handled. The operative secretary to the Wages Board, however, strongly defended the award of the arbitrator, and declared that the Arbitration Board had been the means of getting the men five advances during the years of prosperity, which five advances were equal to the ten reductions to which they had had to submit during the past twelve years of depression.

THE French Minister of Commerce is preparing a *projet de loi*, or Bill, authorising the holding of a Universal International Exhibition, to by held in the Champs de Mars, Paris, in 1889. There is to be no General Commissioner; but the directors of the several departments will be under the immediate orders of the Minister. French representatives abroad are to consult foreign Governments as to whether the exhibition shall be international or not.

TO prevent possible difficulties on the waterway through a lack of water in the summer months, the Leeds and Liverpool Canal Company has constructed a storage reservoir to hold a hundred million gallons of water, at Barrowford, near Colne, for the benefit of the Lancashire portion of the system, and is building another at Winterburn, near Skipton, which is to have a capacity for three hundred million gallons, for the protection of Yorkshire interests on the canal.

THE death is recorded of the Rev. Thomas John Main, formerly Fellow of St. John's College, Cambridge, and a chaplain in the Royal Navy, on the 28th ult. Mr. Main took his Bachelor's degree at St. John's College in 1838, as Senior Wrangler and first Smith's prizeman, and proceeded M.A. in due course. He was for a period of thirty-four years Professor of Mathematics at the Royal Naval College at Portsmouth. *Nature* says Mr. Main was the author of various works on the marine steam engine.

IT is said that Sir F. Bolton is devising, or has devised, a scheme by which Mr. Irving in "Faust" can carry three different coloured lights in the inside of the peak of his cap. By means of these he can illumine his features as he chooses. Another ingenious contrivance for Mr. Irving is to be a sword so tipped that he can at will produce an electric light on the point. When Valentine has fallen, Mephistopheles will point to him contemptuously with this weapon, and the face of the dead man will be illuminated.

MR. F. PROCTOR, of Coleford, Gloucestershire, in writing for further information on the subject of a paragraph in our "Notes and Memoranda," of the 18th ult., relative to M. Rotondi's means of saponifying fats, says he has lately imported a bean into this country which is unknown here, but contains 34 per cent. of a fatty oil. He says it is a good lubricant and illuminant. He believes it especially adapted for soap-making, but when it is saponified by the present ether process an unpleasant smell is imparted to it.

MESSRS. W. H. BAILEY AND CO., of Salford, have supplied to the Government six of their 10-horse power water motors, which are to be used for military purposes in Northern India. These engines, which are of the oscillating cylinder type, will utilise the water power on the mountain sides for hauling up, by means of small trucks on light rails with a wire rope system, men and military stores. We understand that a pressure of over 1000ft. in column of water will be utilised, and that each of the engines will develope about 20-horse power.

KIDDERMINSTER has become alarmed about its water supply. It is stated that the water, which is drawn by the Corporation from the lower well close to the sewage works, has become contaminated, and Dr. Parsons and Mr. Arnold Taylor, inspectors to the Local Government Board, have visited the town this week to make a thorough examination into the question, aided by Mr. Pritchard, C.E., who is the engineer to the works of sanitary improvement now going on in Kidderminster. The Town Council have for a long time been urged to disuse the present well and to sink a new one, and it seems likely that this necessary work will not much longer be delayed.

SOME hardware manufacturers in Birmingham are taking pains to make themselves familiar with the goods of continental manufacturers which come into competition with their own productions. Such a course is worthy of wide imitation, and is the surest road to successful combating of the threatened difficulty without recourse to restrictive tariffs. That in many branches we are behind our continental competitors in the adoption of machine production, which accounts for much of the continental cheapness, is undeniable; nor does it follow of necessity that the continentals are making a profit upon all the trade which they are seeking to do with this country. Trustworthy evidence upon this point is much needed.

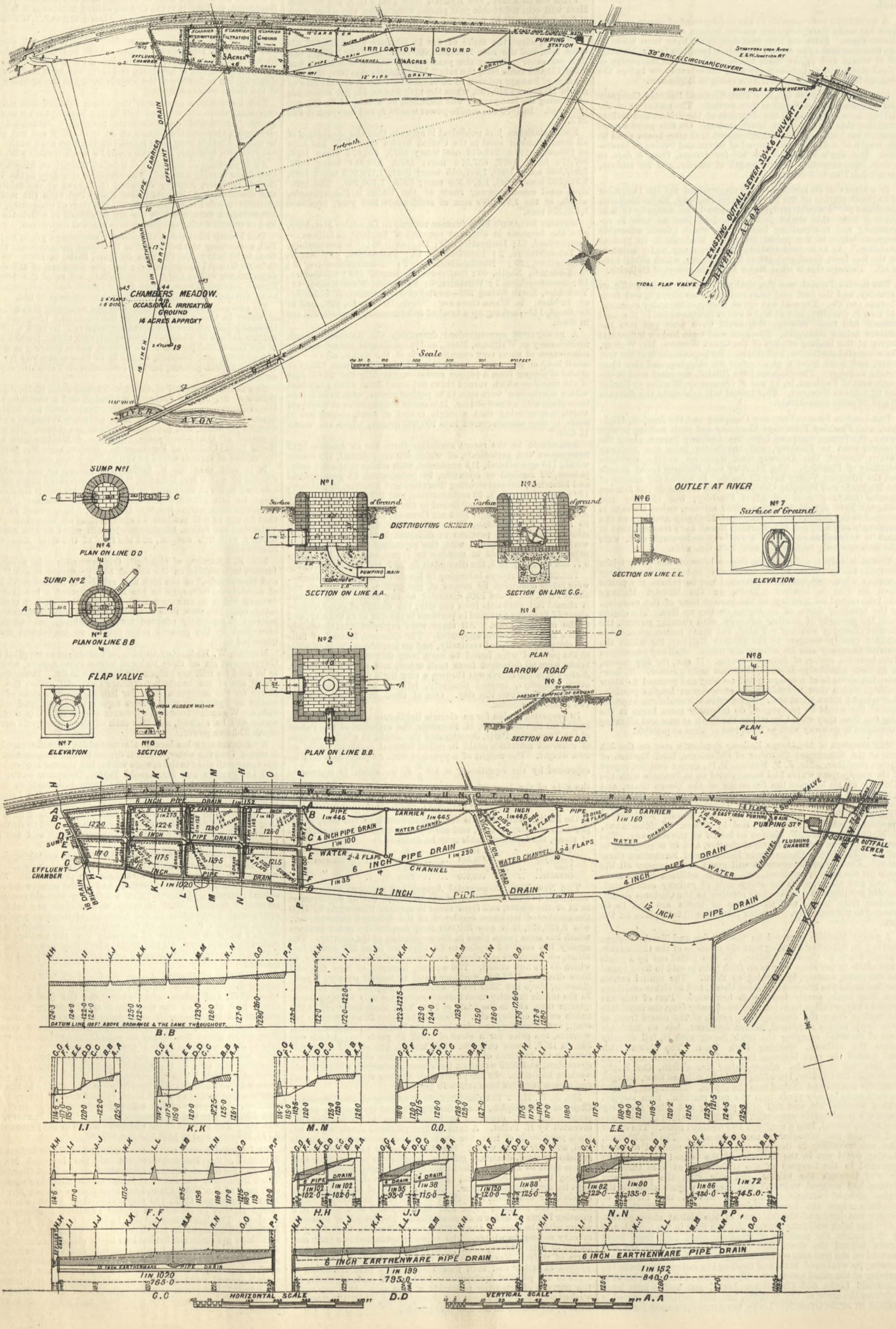
ACCORDING to Messrs. Arthur Bird and Co.'s tin-plate trade report, the course of the tin-plate trade during 1885 was singularly uneventful, and prices, after undergoing but few fluctuations, closed just about on the same level as in January, 1885. We commenced last year with an enormous power of production, and as a consequence, during the first six months prices gradually dropped to about the lowest on record. A combination entered into in July by the majority of the manufacturers to stop all their mills one week per month for the rest of the year, somewhat improved the tone of the market, and placed values on a more satisfactory basis. The improvement in prices, however, was on the whole so disappointing, that it led unmistakeably to the belief that the diminution in the out-turn existed more in theory than in practice. The price of I C coke tin-plates on 1st January, 1885, was 13s. 9d. per box at Liverpool, and on the 1st January, 1886, was 14s. The exports of tin and terne-plates in 1884 amounted to 5,774,160 cwt., and in 1885 to 5,954,560 cwt.

BY Imperial decree, on the recommendation of Sir Robert Hart, K.C.M.G., the Inspector-General of the Imperial Maritime Customs Service of China, a Decoration of the First Class of the Third Division of the Imperial Order of the Double Dragon and civil rank of the Third Class, have been conferred upon Mr. David Marr Henderson, C.E., the engineer-in-chief to the above-mentioned service, in recognition of the excellent character of his services. The decorations of the Imperial Order of the Double Dragon are arranged in five divisions, of which the first, second, and third are again subdivided into three classes each. The first division is for crowned heads, imperial and royal princes, and ambassadors; the second division is for ministers plenipotentiary, ministers resident, and chargés d'affaires; the third division for consuls-general, commissioners, consuls, &c.; the fourth division for subordinate Government employés, both civil and military; and the fifth division for private gentlemen and others not in official positions.

SEWERAGE OF STRATFORD-ON-AVON.—SITE AND SECTIONS OF WORKS & IRRIGATION GROUND.

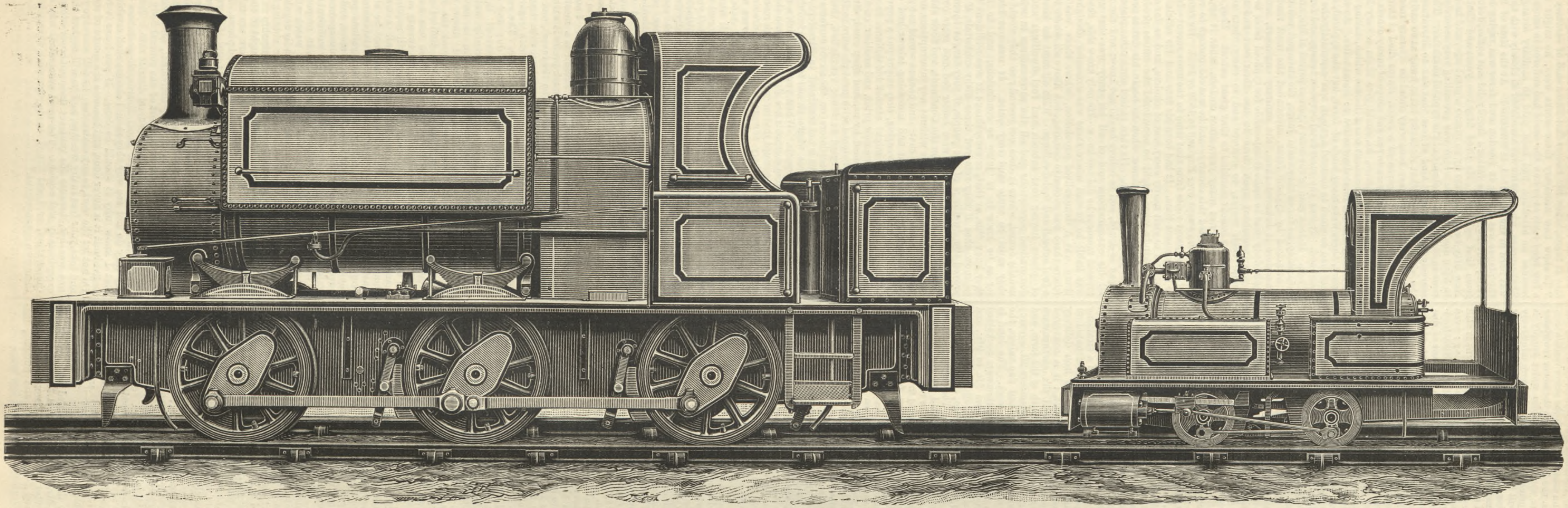
MR. E. PRITCHARD, M.I.C.E., ENGINEER.

For description see page 46.)



COLLIERY TANK LOCOMOTIVES.

MESSRS. JOICEY AND CO., NEWCASTLE-ON-TYNE, ENGINEERS



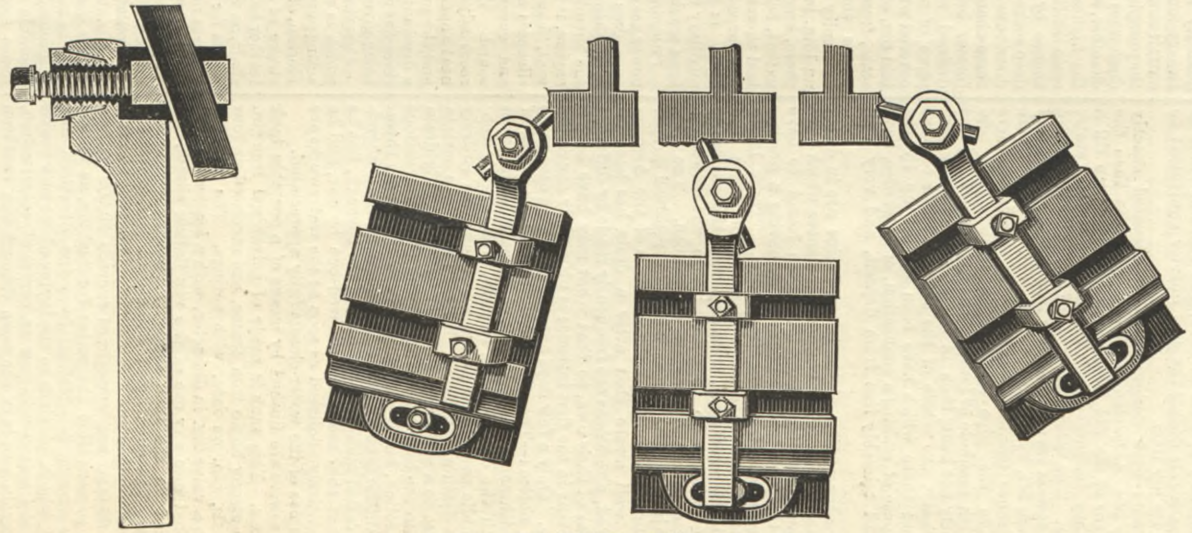
COLLIERY TANK LOCOMOTIVES.

ABOVE we illustrate from a photograph two locomotives, constructed by Messrs. Joicey and Co., Newcastle-on-Tyne, which may be taken to represent the two ends of the scale of sizes, that is to say, the largest and the smallest colliery engines built by the firm.

The large engine has been designed to work the traffic on a heavy gradient from a colliery near Newcastle-on-Tyne. It has cylinders 16½in. diameter, with a stroke of 22in.; six wheels, all coupled, 3ft. 9in. diameter; wheel base 12ft.; grate area, 11·3 square feet; heating surface in fire-box, 75 square feet; heating surface in tubes, 811 square feet; weight empty, 33 tons. The small engine has cylinders 5½in. diameter, with a stroke of 9in.; four wheels coupled, 18in. diameter; wheel base, 2ft. 9in.; gauge of rails, 3ft. 6in.; fire-grate area, 2·3 square feet; heating surface in fire-box, 12·2 square feet; heating surface in tubes 87½ square feet; weight when empty, 62 cwt. It has been built for taking coal from the crushers and running it over the top of coke ovens for the purpose of charging them, and is necessarily light, partly to avoid doing damage to the ovens and partly to suit a light section of rails which were on the ground. Notwithstanding its small dimensions, its regular work in one day of eight hours is to charge 120 ovens holding each 5 tons, thus doing away with a great deal of manual labour which was formerly employed for this purpose. These engines will maintain the reputation of the firm, and are interesting examples of the applicability of the locomotive to very diverse purposes.

NEW SWIVEL TOOL HOLDER.

ONE of the defects in swivel tool-holders is that when the angular adjustment of a cutter is being effected the cutter itself is made free and has again to be set to the work, whilst in like manner in altering or adjusting the angle the cutter is loosened and must be re-set for the two-fold object of angle and work. To avoid this compound setting of the cutter on all occasions, Mr. Gavin Jones, a well-known Indian engineer of large practical experience, has designed a swivel tool-holder, which is shown in the accompanying illustrations. In this tool-holder the two adjustments are effected separately and independently of each other, and a cutter may be swivelled to any angle horizontally without disturbing its position in relation to the work. Our illustrations show pretty clearly the construction and arrangement of these tool-holders, and any further very detailed description is scarcely necessary. These holders are constructed entirely of steel; each consists of a shank of strong form, into which is placed the swivel head, and this is secured in any required position by means of a hexagon nut, which, instead of being flat on the base, has a long cone, by which means the swivel head is gripped much more tightly. The swivel head is slotted out to receive the cutter at a correct cutting angle, and is tapped at the upper end to receive the square-headed screw for tightening the pressure die on to the cutter. The cutter is of bevel section, so that only the cutting end requires re-grinding after wear, and with each tool-holder is supplied a double-ended screw key and assorted tools. An important advantage in this tool-holder is the arrangement of the cone nut and left-handed screw in the swivel head, which renders it impossible for the tool to swivel round under a heavy cut, a liability to which some of the present tool-holders are subject. In fact, with this arrangement the greater the pressure the more tightly is the screw fastened. These holders are applicable to all machine tools in which bar steel tools in general are used, and they have been tried not only at the works of Messrs. Hulse and Co., by whom they are being manufactured, but at some of the largest works in the neighbourhood, with the best practical results.



HULSE'S NEW SWIVEL TOOL HOLDER.

MESSRS. FOY, MORGAN, AND CO.'S ANNUAL WOOD REPORT says:—"The state of business in the wood trade during the past year has been one unbroken record of dulness, except for the three weeks' excitement in April, in apprehension of a Russian war, and stocks in the docks are very similar to what they were at the commencement of 1885. The shortage from Sweden has been more than discounted by the larger import from Russia. It is, however, remarkable that, although the deliveries have been nearly 30,000 standards less, the stocks are not larger in standard quantity than last year; and this is a very healthy feature in the trade, which enables us to look forward hopefully to the future."

THE NATAL WATER SUPPLY.—Progress is being made with the Natal Waterworks at Umbilo, which are being constructed under Mr. R. Barnes and Mr. J. F. E. Barnes, M.I.C.E., the borough engineer. The *Natal Mercury* says:—"The natural reservoir created by the dam was about 3000ft. long by 400ft. wide, and when full to the highest level the greatest depth in the basin will be 35ft., representing a cubical storage capacity of about 30,000,000 gallons, or a daily supply of 300,000 gallons for 100 days were all replenishing shut out of it. The river makes bends almost as sharp as three sides of a square, and as the dam stands nearly midway in the central line, the force of the current, no matter how much swollen, is diverted from the work itself and its impact is destroyed, or directed into the bye-wash. This last work is a fine piece of engineering, being an excavation, 64ft. wide, 11ft. 6in. deep, and 700ft. long, out of the earth and solid rock. In order to preserve the picturesqueness of the spot this bye-wash opens into the stream just above the falls. The upper reservoir being nearly finished, the contractors are now busy on the lower basin, which will be shut in by another bank 230ft. in length, and 126ft. wide at the base. This second reservoir has a capacity of 5,000,000 gallons, or over a fortnight's ordinary supply. From thence the town water supply will pass into the filter beds just below, so that there will be three stages of settlement and purification before the element reaches the pipes. The bottom, we may add, is a clean sandstone, and the soil on either side is sandy in its composition, while the cliffs which shut in three sides of the gorge keep the water in shade during a great part of the day. As to the water, a daily flow of 200,000,000 has, however, been registered by Mr. R. Barnes, the resident engineer. The lowest daily record at the end of a dry season has been 204,000 gallons."

STRATFORD-ON-AVON SEWERAGE AND SEWAGE DISPOSAL.*

MATTERS relating to sewerage and sewage disposal have been so often discussed by the Association that it is somewhat difficult for one to write anything fresh on these subjects, still it may not be uninteresting to some at least of the members present to learn what has been done to improve the sanitary condition of this historic old town.

We have it on the authority of Mr. J. O. Halliwell Phillips that about the year 1551, "and for many generations afterwards, the sanitary condition of the thoroughfares of Stratford-on-Avon was, to our present notions, simply terrible. Under-surface drainage of every kind was then an unknown art in the district. There was a far greater extent of moisture in the land than would now be thought possible, and streamlets of a water-power sufficient for the operations of corn mills meandered through the town. This general humidity intensified the evils arising from the want of scavengers, or other effective appliances for the preservation of cleanliness. House-slops were recklessly thrown into ill-kept channels that lined the sides of unmetalled roads; pigs and geese too often revelled in the puddles and ruts; while here and there small middens were ever in the course of accumulation, the receptacles of offal and every species of nastiness. A regulation for the removal of these collections to certain specified localities interspersed through the borough, and known as common dunghills, appears to have been the extent of the interference that the authorities ventured or cared to exercise in such matters. Sometimes, when the nuisance was thought to be sufficiently flagrant, they made a raid on those inhabitants who had suffered their refuse to accumulate largely in the highways. On one of these occasions, in April, 1552, John Shakespeare was fined the sum of twelve pence for having amassed what was no doubt a conspicuous sterquinarium before his house in Henley-street, and under these unsavoury circumstances does the history of the poet's father commence in the records of England." The town now enjoys the reputation of being a very clean and well-kept one. The area of the borough is 3865 acres, the population computed to date is 8400, the rateable value is £31,710, and the death-rate during the past quarter equivalent to an annual rate of 14·8 per 1000.

Sewers.—The sewers were designed and constructed exactly thirty years ago by Mr. Alderman E. Gibbs, who was then the engineer and surveyor of the old Board of Health, and up till a few months since they discharged their contents, in a crude state, into the river Avon. The system is that known as the combined system. The pipe sewers vary in diameter from 9in. to 18in., and the brick sewers from 3ft. by 2ft. 3in. to 4ft. 6in. by 3ft. There are several side entrance manholes to the main sewer, but there are no manholes to the pipe sewers, the straight line and gradient system, with manhole or lamphole at each change of line or gradient, evidently not being then in vogue. From an inspection of the plans, nearly the whole of the sewers appear to have good gradients, and those which have been opened up by the author for the purpose of making a connection, or otherwise, have generally been found tolerably free from deposit, and very well constructed.

Drains.—The greater portion of the house drains are in direct communication with the sewers, and in many instances which have come under the author's notice they have been found to have uneven gradients, the street portion frequently having a precipitate fall at the expense of the house portion. These latter have generally been found to contain deposits of ashes and other matter in a decomposed state, it having been the custom to allow ashpits and middens to be drained into the sewers, a practice which cannot be too strongly condemned. The construction of the majority of the drains may have received proper supervision in the first instance, but the members of the Association are only too well aware that after a drain has been inspected and approved, alterations are frequently made by different men possessing ideas of their own, so that what may have been a very good arrangement in the first instance is ultimately converted into a very bad one. Only a few days ago the following case came under the author's notice:—The waste pipe from a bath in one of the principal establishments of the town was found to be in direct communication with the drain, which, in turn, was directly connected with the public sewer, and as the waste-pipe was entirely untrapped and the drain unventilated, this pipe was, to a certain extent, doing service as a ventilator, and conveying not only drain air but sewer air into the bath-room; there were also other serious defects in the connection, but it is unnecessary to enumerate them.

Middens.—The author is sorry to say that many of those abominations commonly called middens still exist in the borough, but he is pleased to say that they are being removed one by one, and he hopes to see them entirely abolished as soon as the waterworks are completed, and the use of the water-closets fully appreciated.

Flushing.—The sewers are flushed by means of a portable tank holding 1000 gallons. This tank is made of galvanised iron $\frac{1}{8}$in. thick, rivetted to a strong angle iron frame, and mounted on four wrought iron wheels, 6in. on face, with springs. The water is discharged through a valve 9in. in diameter, with a leather sleeve; this sleeve is inserted into any one of the ventilation shafts, and the water contained in the tank suddenly discharged into the sewer to be flushed. The quantity of water used is regulated to suit the state of the weather and the amount of rainfall, but it is seldom less than 20,000, and sometimes exceeds 40,000 gallons per week. At the present time the water for flushing, as well as that used for the streets, is obtained from the Stratford and Birmingham Canal, which, previous to the laying of the new mains in connection with the waterworks now in course of construction, was conveyed to certain points in the town through 6in. cast iron pipes; these pipes are now connected with the new mains, and the canal water is at the present time, and will be, until the new supply has been turned on, in circulation throughout the greater portion of the system. A sum of £70 per annum is paid to the canal company for this water. It may also be mentioned that the above arrangement gives the town a certain amount of protection in case of fire. When the waterworks are completed, it is the intention of the author to recommend the construction of automatic flushing tanks at the upper ends of the sewers. The order of flushing commences at the lower portions of the system, the higher portions or dead ends being flushed last of all.

Ventilation.—The sewers are principally ventilated by means of 9in. and 6in. earthenware pipes carried up from the crown of the sewers and surmounted with cast iron ventilating covers flush with the surface of the roads; these are placed at an average distance of 65 yards apart. Complaints have been pretty freely made from time to time concerning offensive smells from the ventilators, and in some instances cast iron shafts have been carried up the sides of houses and buildings, the offensive surface ventilators being then closed. At the present time there are twenty-six of these shafts, the greater portion being only 5in. in diameter; those recently erected, however, are 6in. in diameter. Unfortunately complaints are still made, and certainly not without foundation, that some of the surface gratings do occasionally give off very offensive odours. Such being the case, it will naturally be thought by the members of the Association that something must be wrong with the system, and, in the author's opinion, something is wrong, and it remains to be determined whence the evil arises. The sewers appear to have been well designed, and, as far as can be ascertained, they also appear to have been well constructed. The house connections, then, must be the cause of the emanations; they are untrapped, and owing to faulty construction in some instances, and to the want of flushing in others, they are slowly discharging decomposed matter into the sewers, and as most of the drains are inadequately ventilated, and even in some instances not ventilated at all, the gases generated therein find an escape through the sewer ventilators. It is the prevailing opinion in the borough that the sewer ventilator nuisance will be obviated as soon as the public water supply is fully laid on so that the private drains may be more effectively flushed. Such, of course, will be the case to a large extent, but it is extremely doubtful whether some of the partially choked drains, particularly those in connection with ashpits and middens, will ever be thoroughly cleansed by such means.

New Sewage Works.—The disposal of the sewage of towns is still recognised as one of the great sanitary problems of the day; even the metropolis is greatly perplexed with the question. Stratford-on-Avon, therefore, in having provided itself with a means of disposal, may be congratulated on having so far got out of the difficulty. After being threatened time after time with injunctions to restrain them from polluting the river, the Town Council, in 1880, determined to take action, and, after carefully considering various reports and schemes from my predecessor, Mr. J. B. Denton, and others, Mr. Pritchard, in 1882, was called in to report upon the several schemes submitted, and was ultimately instructed to carry out a scheme of his own. This has just been completed, and the following is a brief description of it. The scheme is a combined irrigation and filtration one, and the land—see page 44—purchased from the late Marquis of Hertford, is twenty acres in extent and particularly suitable for the purification of sewage, the soil being of a light loamy nature, varying in depth from 18in. to 24in., overlying a deep bed of gravel and sand. Three-fourths of this land—fifteen acres—have been laid out for surface irrigation, and the remaining fourth—five acres—has been divided into eight beds for intermittent filtration. Pumping has had to be resorted to, as a portion of the town is situated at such a level that suitable land in the neighbourhood could not be obtained for a gravitation scheme. The dry weather flow of sewage is about 162,000 gallons in twenty-four hours, which is after the rate of $20\frac{1}{4}$ gallons per head per day calculated on a contributing population of 8000. A rainfall of ·22in. in twenty-four hours increases the volume to 238,000 gallons. Provision, however, has been made for a prospective population of 10,000, at the rate of 40 gallons per head, with the addition of 100 per cent. of rainfall, making a maximum quantity to be dealt with in the future of 800,000 gallons in twenty-four hours. The sewage is intercepted at a point on the outfall sewer 470 yards from its outlet at the river and conveyed to the pumping station through a 3ft. brick sewer—see page 48—which discharges into the pumping well after passing through a straining chamber, see page 8; it is then pumped up to a chamber situated on the highest part of the farm, through a 9in. cast iron delivery main 425ft. in length, the vertical lift being 25ft.; it is conveyed thence by gravitation through 12in., 9in., and 6in. earthenware deep socketted pipe carriers throughout the length of the farm, and distributed thereon by means of distributing chambers 2ft. square; these chambers are fitted with cast iron disc and flap valves, the former being particularly effective in their work. The land is drained with 15in., 12in., 6in., and 4in. earthenware socketted pipes of second quality, varying in depth from 5ft. to 9ft., and covered with assorted gravel for a depth of 18in., upon which is laid 6in. of puddled clay to prevent the sewage, in an unpurified state, from passing direct into the drains. The sewage effluent passes through an effluent chamber situated at the western extremity of the farm, and from thence into the river by means of an 18in. brick drain laid through the intervening meadows; one of these, known by the name of Chambers' meadow, fourteen acres in extent, belongs to the Town Council, and a 9in. carrier has been laid thereto and distributing chambers have been constructed, for the purpose of distributing sewage upon it when considered desirable. It is expected that this meadow will make a very good auxiliary to the sewage farm by giving it a greater season of rest than would otherwise be the case.

Pumping station—engines (*see page* 8).—There are three 6-horse power gas engines of the Otto type, with self-starting gear; this, however, does not appear to be necessary, as the engine man prefers to start them, and can do so easily, from the fly-wheels. As most of the members of the Association are familiar with this type of engine, it is quite unnecessary to describe it in detail. It may be well, however, to mention the following points. The exhaust silencers are fixed in a brick chamber outside the engine-house and covered with coarse gravel which materially deadens the sound. The water tanks and gas meters are placed in a separate room adjoining the engine-house, which helps to give the latter a neat appearance. The Town Council manufacture their own gas, and the price charged by the gas department is 3s. per 1000ft., less a discount of 10 per cent. Of course sufficient time has not elapsed since the starting of the engines to allow of any reliable information being given as to the working expenses, &c.

Pumping machinery.—The pumping machinery—see page 8—which is situated inside the engine-room, consists of three double-acting pumps, patented last February by the makers, Messrs. Ball and Horton, of this town. The cylinders are 10in. in diameter, and the stroke of the piston is 18in. The pumps are driven by means of leather belting from broad pulleys on the engines direct to a counter-shaft, on which are placed fast and loose pulleys having lever arrangements for sliding on and off the driving belts. The counter-shaft imparts motion to the pumps by means of spur-gearing, the pinions having lever arrangements for throwing them in and out of gear. These levers, together with the levers for sliding on and off the driving belts, are all concentrated at one point, and can be readily manipulated. Each pump is capable of lifting 350 gals. of sewage per minute 25ft. high, and the arrangements are such that each engine may work any one or more of the pumps, or the three engines may be employed to work the whole. The pumping well is situated immediately outside the engine-house, which has the desirable effect of freeing, to a considerable extent, the engine-house from sewage odours. A pair of sludge agitators is fixed in the well, but these are not often required. The pumps will be much better understood from the drawings, but the principal features are as follows:—The valves consist of rectangular metal flaps with india-rubber facings, which are set at an angle of about 45 deg.; and it is claimed by the patentees that all solid or foreign substances lodging within the valve openings, or between the valves and their seats, are dislodged on the valves again lifting, or on the return movement of the piston. The pistons or buckets are composed of india-rubber gripped between two metal plates, with an intermediate packing of hard wood, consisting of segments placed endways to the grain, to prevent any metal from coming in direct contact with the cylinders. These cylinders are lined with solid-drawn hard copper $\frac{1}{8}$in. thick. At the side of the pump casing or jacket, and directly opposite each valve, are fixed small hand or sight lids, for the purpose of examining or gaining access to the valves or passages without having to take off the larger covers. These small lids are opened or closed in a few seconds by means of a vice handle and screw set-pin, working through a cross or catch-bar, and they answer their purpose exceedingly well.

Cost.—Although the works are practically finished, they are not quite out of the contractors' hands, and therefore their exact cost cannot be given: approximately, however, it is as follows:—

	£	s.	d.
Cost of land and compensation to tenants	4400	4	6
Engine-house and chambers adjoining..	871	9	0
Engines and pumping machinery	1200	17	0
Intercepting outfall sewer..	830	14	0
Cast iron pumping main	62	18	0
Irrigation grounds, including Chambers' meadow and occupation road	1618	12	0
Filtration beds	781	5	0
General charges	183	0	0
Total cost	£10,008	19	6

The outfall works were designed and carried out by Mr. E. Pritchard, M.I.C.E., with Mr. J. E. Willcox, A.M.I.C.E., as resident engineer. The contractor for the general work is Mr. George Law, of Kidderminster; and for the engines and pumping machinery, Messrs. Ball and Horton, engineers, of this town.

After the members had visited the water and sewerage works they met at lunch, when Sir Robert Rawlinson said of sanitary works: "To show how necessary those works were, he might mention a few brief facts as to how the world had suffered in times gone by because no attention had been paid to sanitary arrangements. Shakespeare, whose name was associated so closely with that town, was born in the year 1564, in Stratford. At the time of his birth the plague was raging in London and fever was raging in Stratford; but he and his father's family did not suffer, fortunately, from that epidemic. He lived fifty-two years and died in 1616. Now fifty-two years was by no means a great age, and he was said to have died of a fever which was prevailing very severely at that time in that town, probably of the typhoid character. They could scarcely imagine what kind of loss that was to literature and to the world—a life of that character taken away at so early a date. Fever appeared to have been very fatal to literary men. Lord Byron died at thirty-seven of a fever, Burns died at thirty-seven of a fever, and if he were to run the range of many others who had died similarly from fevers, he could give them a very long list. Fever at the present moment was a disease which, taking it in all its forms, was the most destructive to human life. As they were aware, there were many kinds of fever, but the typhoid, of which they had so much to contend against, was essentially the fever of manhood. It was the most fatal between twenty and forty years of age. It took man in the most vigorous period of life, and almost invariably, as far as they could judge, the strongest constitutions, if attacked by typhoid fever, succumbed the most readily to it. Therefore it behoved them, the sanitary engineers, seeing that their duty was to make it impossible for typhoid fever to prevail, it was incumbent upon them to use their best endeavours to devise their works, to execute and to carry them out, that they might benefit mankind to that great extent. They all knew that it was not many years since cholera, when it appeared in Europe, visited this country—and he was old enough to remember that cholera swept over England in 1832 or 1833. He remembered its subsequent visits from that time to the most recent—from 1848 to the present time. It had been his fate and his official duty in England to visit nearly every seat of cholera, and as far as in him lay to study what might be considered the causes producing it. Now, he thought he knew when he began his duties pretty well what produced cholera. He then visited some other places and he began to doubt, and to believe he did not know; and the result of all his examinations and of all his study was that up to the present moment he did not know. He only knew this, that cholera was liable to prevail where there was excessive drought, where there was a demoralised population, where there was poverty, where there was excessive drinking, but above all where there was a foul subsoil and foul dwellings. With all that he knew plenty of places having foul subsoils and foul dwellings and having demoralised populations and all the surroundings in which it is usually found, where it does not prevail; so they would see that they must be mute and very quiet. It was not his duty as far as he knew it to jump to conclusions, and to say that they knew this, or that, or everything; it was sufficient for them to know that if they removed those filthy materials, if they improved the dwellings of the people, if they taught them to lead more moral lives; if they were better fed and more contented; that cholera might prevail on the Continent, and their ships might run backwards and forwards without any interruptions or quarantine—he would go as far as that—and cholera would not prevail in this country. By constant and unceasing labour and care and cleanliness, and care in scavenging, they might put a population in such a condition that they might almost bid defiance to cholera."

After the paper which we now print, and another on the water supply also recently published by us, had been read, Sir Robert Rawlinson said: "I have listened with great pleasure to the papers read, and in one, with regard to sewer ventilation, there is the remark that the open ventilators on the street surfaces are very offensive. This complaint is not restricted to Stratford-on-Avon, but is common to all places where an old town has indulged itself for generations with cesspools. When you sewer such a town, the corrupt contents of these cesspools are discharged into the sewers, and one gallon of such corrupt matter would be much more tainted and offensive than ordinary sewage from a well-drained town. You must not, therefore, conclude that your sewers are badly formed or badly ventilated, because in their present state you are suffering from that temporary nuisance which will abate most unquestionably when houses are properly drained and cesspools are abolished. I think my friend Mr. White will tell you he has found this to be the case in Oxford—that the ventilation of the sewers was protested against, but that it was really due to the horrible matter sent in from the cesspools which caused the nuisance. All the old sewers in the town are practically choked; and the sooner the inhabitants of Stratford-on-Avon, when they have got proper sewers, can get rid of their old drains, the better. Then with regard to the flow of the sewage over the ground, I heard nothing about the subsoil. I hope that there is some subsoil water in the sewers. Sometimes persons who have no practical knowledge of drains want you to take out the subsoil water, and to take in the surface water. I am no such advocate. A dry drain laid upon a dry subsoil is a most difficult thing to keep in order. I should very much prefer it with as much water in the sewer as would equal 3in. on the invert, and I should much prefer to have it, even if I had to contend with it at the outfall where I had to treat the sewage. Then with regard to the water supply, there is one caution I would give. The reservoir is comparatively small for the work it has to do; and I would caution the person who has the management of it, because he has the reservoirs full during an apparently wet season, not to be extravagant and to pull it down, in anticipation that it will avail them in time to come. I know of cases where the reservoirs have been pulled down at the beginning of a dry period, where there was only a limited gathering ground; and in one particular instance there was no rainfall upon that area, in this country of England, for twenty months, to fill the reservoir. This reservoir at Stratford will require careful management. Extravagance in water, like all extravagance, should not be tolerated; and a house should not be allowed to waste from leakage in the service. For any establishment with proper waste-prevention fittings ten or fifteen gallons per head is the best supply a house can have. It wants no more, and ought to have no more; and whoever may have the management of the waterworks in the future should take care to pay sufficient attention to maintain the fittings, which will be put in, in proper order in perpetuity. One might as well expect that a watch will go well and keep proper time if it is roughly handled, badly regulated, and neglected. Perfection of workmanship goes for nothing if proper care is not paid to it, and perfection of workmanship in sanitary matters will not go for one-tenth of what it ought if there is not subsequent care. I am very sorry to hear there are middens in Stratford-on-Avon, and that there are uncleansed places. The foundation of all sanitary science is scavenging; and if I were asked what is the most important feature in sanitary science, I would repeat again scavenging. Your sewers, your drains, and water supply are all secondary considerations if scavenging is neglected. There should be no vested interest in effete matter. It should be removed from the premises of every individual, and every manufactory, and every place, at the cost of the general body, and the cost should be paid out of the general district rate. This is being contended against by some Local Boards, the members of which say they do not see why they should cleanse such establishments. But I know why it should be done. If you leave it to private individuals it is never done, and becomes the source of serious evil. Do not let the work to any contractor; he will scavenge your town and take your fees in dry weather, and he will neglect the work in wet weather, because his contract does not cover exceptional or exceptionally wet seasons. The most economical way is for the Corporation, or Local Board, to do the work themselves, under their own management."

* Paper read before the Association of Municipal and Sanitary Engineers and Surveyors by Mr. Alfred T. Davis, Assoc. M. Inst. C.E., Borough Surveyor.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE, CHANCERY DIVISION.

Before Mr. JUSTICE PEARSON.

OTTO *v.* STEEL.

Mr. MOULTON, in opening the case for the defence, stated that he did not in the least underrate the difficulties under which he was placed, in having to contend against the validity of a patent which in another case has been supported in the Court of Appeal. He thought he should show his lordship on the evidence that the Court of Appeal decided the case as a matter of law on the findings of fact which he should be able not only completely to displace by his witnesses, but he should be able to show to his lordship that the very witnesses for the plaintiff have turned round and before his lordship put forward a case, not only different from that which was made in the former case of Otto *v.* Linford, but absolutely inconsistent with it. In Otto *v.* Linford the Court from imperfect evidence come to this conclusion, that the patent must be supported for the invention of a gas engine on account of its non-explosive character, and he should show his lordship that the main advantage of the Otto engine is that it is so intensely more explosive than anyone that ever preceded it; and that it is through that that it has been the great success it has. They not only did that, but they also decided against the defendant in that case on the ground that previous engines worked explosively and with shock when they were the mildest of combustions compared with what took place in the very engine made under the Otto patent. The very witnesses for the plaintiff in this case have again and again admitted that the combustion is more gradual with uniform dilution than with an irregularly diluted mixture. It was supposed in Otto *v.* Linford, and it was testified to by the witnesses, that in previous engines there was a combustion of a very explosive kind; but here the very opposite is set up, and when he came to refer to the re-examination of Mr. Imray, he thought his lordship would see that his evidence alone would have been sufficient to defeat the case on which the plaintiffs won in the Court of Appeal in the last case. It would be necessary for him to put before his lordship as shortly and as clearly as he could real fundamental scientific facts on which the whole of this question turns. The case before was won by juggling with the word "explosive." He did not use the work "juggling" in any offensive sense, but they played with the word "explosive," and that completely deluded the Court. He did not mean to have any such juggling in this case, and he wanted to show first exactly what "explosion" is, and all its incidents. All motive power of this type is got directly or indirectly from heat, and in all engines, whether they be steam or whether they be gas, you have this motive power got through the medium of an elastic fluid, a gas, or air, or vapour, which is expanded by heat. If you heat a gas the pressure gets greater, it drives out the piston, and in driving it out does work and cools itself. In the gas engine the heat is got by the combustion of a hydrocarbon coal gas, which unites with the oxygen of the air and forms carbonic acid or other incombustible gases, and water, and in doing so gives out a large amount of heat. Now that heat must heat something. The consequence is it heats these products of combustion and that causes an immense pressure. The process is, union of oxygen with the combustible gas giving out heat. That heats all the gas it can get hold of. According to the temperature to which it raises the gas is the pressure, and it is because it rises to a high temperature that we have so high a pressure. Take oxygen and coal gas alone in a chamber. There is just as much heat given out in the combination of that gas with the oxygen when it is quite alone as there would be if there was a lot of other gas in the chamber. The amount that is given out by the combustion of a cubic foot of that gas is known accurately to all scientific men, and has been known for fifteen or twenty years. But if they are quite alone in the chamber there is only just that very gas which has produced the heat there to be heated, and such a vast amount of heat applied to so little gas raises the temperature enormously, and as it raises the temperature enormously it raises the pressure enormously. Not only does it do that, but, of course, the chamber is comparatively small, and is filled with nothing but the very gas that is burning, and the combustion is extremely rapid. Then you get a very extreme pressure in a very short time, and you get the true characteristics of an explosive combination of gas. Now, my Lord, supposing that into that chamber which contains coal gas and the requisite oxygen you introduce four times as much nitrogen as there is oxygen; in other words, if instead of mixing coal-gas with the oxygen necessary you mix it with the air necessary, what is the consequence? There is just the same amount of heat developed, but you have got three times as much gas. You have all that extra nitrogen; you have got to expand or heat again so much more gas that the temperature is far lower and the pressure is far lower. More than that, the combustion is slower, because the combustible particles are at shouting distance and not speaking distance. All particles of gas are at a distance from one another. That is a characteristic of gas; but here you have a slow combustion with less temperature, in spite of your having the same amount of heat generated. The consequence is, you have a far less explosive action. Still the rise is very quick, still the rise is very great, but still the pressure is neither so great nor the time so short as before, and you have a much less explosive action. Having taken the coal-gas and taken the requisite amount of air, let us add some more gas of any kind—not coal-gas, but gas not combustible. That acts just as the nitrogen did, and in no other way. It is there to take up heat; it must have its share; it is there to hinder combustion by making it slower, and the consequence is you have a still less rise of pressure, a still longer time in it, and a still less explosive type of action. If this is kept in mind, the whole meaning of the word "explosive" is absolutely unnecessary. What was popularly and scientifically meant by explosion was an action which in an incredibly short space of time produces a pressure that did not exist before. He could understand no other meaning of the word "explosion," and there is not an explosive action in which this does not occur, and there is not a case in which that occurs in which we do not call it "explosion." That was the definition of the word "explosion" on which Otto *v.* Linford was fought. What was the characteristic consequence of an explosive action in these gas engines, as put forward in that case? It was shock. Now, shock is produced by sudden pressure. There was pressure of course before. You cannot have gas contained in any chamber without there being pressure on the walls. Therefore, sudden pressure means considerable rise of pressure in a very short time, and that is just what does cause shock, because shock comes by the sudden change of pressure between two bodies. Two bodies are at rest, that is, touching one another we will say. There is no force from that pressure; it is perfectly silent. But if you suddenly alter the pressure here, this one demands from that sudden and new support, and the consequence is there is impact and shock. Shock is simply rapid increase of pressure on bodies which, before that, were not exposed to that pressure. Therefore, if explosion was the thing which caused shock, it must be that explosion meant a rapid increase of pressure, increased through a great range in a very short time, and so far as he could see, as he had said, there is nothing else in explosion, and certainly, if that is not what is meant by explosion, shock is not a natural consequence of it. With regard to shock, it is quite clear that the shock is caused by rise of pressure, so that the shock, as Sir Frederick Bramwell admitted, is caused during the time that the pressure rises to its maximum. He should call evidence of the most competent people, and would show his lordship that the time of rise to maximum pressure in the Otto engine is just about the same, if not less, than in the Lenoir. Take it at the thirtieth of a second, and he should show you that in the Otto it is very often a sixtieth. The rise in pressure in the Lenoir in ordinary working is about 40 lb., and the rise in pressure in the Otto in ordinary working is 120 lb. to 160 lb. The pressures of the Otto engines are tremendous; the rapidity with which they come on to the piston is at least as great, if not greater, than in the Lenoir engine, and the consequence is that so far as explosion goes the Otto engine is at least four times as explosive as the Lenoir, and it was a new departure in the way of explosiveness rather than on the contrary, as it was represented to the Court above. With regard to the suggestion of the plaintiff's witnesses that there was shock in the earlier engines, and that in Otto's there is not so much shock, the circumstances were quite different. In the Lenoir engine you might get symptoms of shock where you would not get it in the Otto, for a very simple reason. In the Lenoir engine you draw in your charge, and your connecting-rod was then slightly in a state of extension as it was drawing in. Then came the sudden pressure, which pressed the connecting-rod hard up against the crank and drove it round; there was a change from the piston lagging back to the piston bounding forward. If your brasses were loose at all, then the moment before the ignition the axis would be drawing on the connecting-rod; the moment after it would be the opposite way, and you might have knocking in your brasses, not from any shock such as we have been talking about, but from the fact that there was a rapid change from, as it were, tension to compression in the connecting-rod. In the Otto engines you are compressing the charge hard at the very moment of ignition, so that the consequence is, your connecting-rod is pressed hard up against the crank at the moment when the ignition takes place, and there cannot be any play whatever. So that in the Lenoir you might get noise if you were not careful to have those brasses done up tight with a very small increase of pressure, whereas in the Otto, although the pressure was so much bigger and came on so much more rapidly, you would get no knocking at all. The method by which compression took place at the moment when the firing took place was not original, and in fact it was not claimed. He never attempts to claim that, but this is one of the reasons why, with his violent engine, he has had the reputation of having a silent one. The violence of the action in the Otto engine should be measured before his lordship by means of diagrams. There was another point to which he must draw attention. The witnesses who were called for the plaintiff spoke of its being possible to get shock from the Lenoir, and they say that when it was made to do work they got shock. Now, upon asking them how they got the shock they said this:—If you made it to work and altered the gas cock so that the mixture was richer, then you might get shock. Just see how unfair that is. The engines did the work they were meant to do with dilute mixture of about 11 to 1. In order to make it do more work than that you alter the gas cock and work it with a 7 to 1 mixture or an 8 to 1 mixture, the most explosive mixture you can get, because that only just supplies the right amount of oxygen for combining with the gas. Of course you get a rapid combustion then, and you are making the engine do far more than it ought to do. Its ordinary work is with an 11 to 1 mixture.

In answer to Mr. JUSTICE PEARSON, who said that as he understood, the witness said, when they tried it with 11 to 1 the engine would not do its ordinary work, and they were obliged then to alter the mixture to get any work out of the engine, Mr. MOULTON stated that if the witnesses said that, he should show that they were not correct beyond all doubt. But they have never shown what work they were trying to get out of the engine when they went to 7 to 1. In any case 7 to 1 would make a shock naturally, whatever was the engine. The Lenoir was a feeble engine. It was far feebler than the Otto, but whether in fact it was an engine that gave shock is not told by trying it with a mixture so strong that it must make shock in any engine at all.

Mr. ASTON: Not in the Otto.

Mr. MOULTON: It is quite independent of the engine; it is a question entirely of the mixture. In the regular work which it did, and was known to do for years, it worked with 11 to 1, and that was recognised as the regular mixture. The witnesses have tried to put upon the Lenoir the consequence of a shock when they prevented that amount of inert gas being present to take off the excess of temperature which was always in it when it was in ordinary work, and then they turn round and say that engine worked with shock. That is no more a fair example than the example which was given by Dr. Otto in his deposition. He said he made an engine and he tried it working the Lenoir fashion and working his fashion; with the Lenoir fashion it gave a shock; with his fashion it did not. He was asked, Did you work it with the same combustible mixture? and answered, Yes, I did. Therefore he was comparing exploding a strong combustible mixture with exploding a strong combustible mixture and some inert gas, and he found the latter much more gentle than the former. With the Lenoir engine the people who knew that 8 to 1 and 7 to 1 supplied all the air that could be used—for this is knowledge of old date—deliberately worked with 11 to 1, which meant that they knew that they put in beside all the nitrogen three volumes of atmospheric air that was absolutely inert and deliberately worked with that. At that time Dr. Otto compares an explosion of 8 to 1 with an explosion of 11 to 1 with this extra charge, and then he says because the latter is more gentle, machine prevents shock, and the other does not. If he wanted to make that comparison he should have taken the one charge 11 to 1 uniformly diluted, and the other three volumes, as he calls it, in front, and the 8 to 1 coming after, and if he had done that he would have found no difference; but he was comparing two charges differently constituted, one with a great deal more inert gas than the other, and he puts that down to the arrangement of the gas, instead of to the separating of the gas.

Mr. JUSTICE PEARSON: If I may stop you for one moment, suppose in the use of 1 to 8, with three volumes of air in front of it, you get much better and more rapid ignition—more certain ignition—than you get with the use of 1 to 11, is that an alteration or an invention?

Mr. MOULTON: That would be a thing of great importance. It is not what Otto claims. He could not, because he took his ignition ready-made from Hugon. He should show that Hugon ignited exactly as Otto did, in the richest part of the charge. The reason Dr. Otto made an admirable engine was this: he put an engine into the market which used compression. For thermo-dynamic reasons the advantage of lighting your gases when they are under compression is enormous. Lenoir and Hugon had not got that; they were not anything like so economical as Otto's, and therefore Dr. Otto came with an engine which was intensely explosive, and got its pressure on rapidly at the beginning of the shock, and which utilised thoroughly, and in a most practical manner, compression. Now that utilisation of compression is a thing the value of which is extremely great. His witnesses will tell you that practically it is so, and he doubted whether he was wrong in saying that it doubles the economy of the engine. If he could get in Beau de Rochas, he should show that he worked out Otto's cycle for the very purpose of utilising this all-important thing. There is not the least doubt, therefore, that there was great merit in Otto's silent gas engine, and if his claims were for that engine, then he should have a very difficult patent to beat on the score of merit, that is, utility. He should show his lordship that the success of the Otto engine arises from the admirable practical details of it, the simplicity of it, and in fact, he might almost say the modesty of it, because you see he contents himself not only with a single-acting engine, but an engine that acts only at every other stroke. The others plunged at once into all the complexities of a double-acting engine. Dr. Otto was an admirable practical mechanician, and he invented a machine which had modest aims, and which used the extremely important principle of compression, and he has deserved the success which he has had, and which has been of a most stupendous character pecuniarily. But his claims he never deserved. He claims here such a thing as this: "Admitting to the cylinder a mixture of combustible gas or vapour with air separate from a charge of air or incombustible gas, so that the development of heat and the expansion or increase of pressure produced by the combustion are rendered gradual." Now that does not give his engine. If he could show that that had been done before, what has the merit of his engine got to do with his right to keep that claim if he did not embody that which was common knowledge, along with other things, supposing it had been done before? He was not attacking the claim that Dr. Otto's engine has to a patent of a proper kind, based on the amount of merit in the invention. If it was a claim for that specific engine, in his opinion, the merit of the engine would overtop almost all arguments against its novelty or anything of the kind. Under such circumstances he could understand a Court going very far to support a patent that is imperfectly drawn up; but when the claim is not for the specific engine, but is of the widest possible character, all he could say is they have no right to appeal to the merit of the engine to support this which is no engine, and a very doubtful feature in the invention itself.

Mr. JUSTICE PEARSON: You say the first claim is bad?

Mr. MOULTON: Yes, the first claim is bad.

Mr. JUSTICE PEARSON: What do you say as to the second?

Mr. MOULTON: With regard to the second, if he could not get Beau de Rochas before you, the second claim he could not contest. He should prove if he did get Beau de Rochas in, that it is the precise cycle that Beau de Rochas published, and not only published, but published in the most intelligible manner. He could not say that it was otherwise anticipated, and, therefore, so far as the second claim goes, he should not continue to contest the case. Therefore the fight really comes on the first one. His lordship must not imagine that this is an attempt to get rid of a patent, because there is an unimportant claim which is a bad one. Otto *v.* Linford was fought entirely on the first claim, and won on the first claim. It is clearly by the first claim that Dr. Otto has strangled out all other inventions during all these years. One of the witnesses he should call before you, whom he confidently put forward as the man who knows in England most about gas engines, has invented the engine which was to be fought in Otto *v.* Sterne. That engine he will show you —it has been referred to in evidence, and it will have, to a certain extent, to be gone into—was very nearly a Barnett engine. It wa an engine on the lines of Barnett, and probably the best engine in the market. His latest invention is still more closely Barnett, who he confidently put before your lordship was a man of immense genius, who was before his time, and whose engines probably will be the engines of the future. They are the engines of the present, as far as economy goes, and the gentleman he was going to call will show that these engines which were really carrying out an idea known thirty years before Otto's, and not in any way imitating Dr. Otto's cycle, were superseded or set aside by Dr. Otto solely because of the width of this first claim, which in his opinion includes every gas engine almost that has ever been made. The idea that leaving products of residuum in was an advantage—that it was an advantage novel in 1876, and that it operated in the way described in this patent—all those three ideas are, in his opinion, astonishing delusions, and he should not use language as strong as that if he did not think he could bring your lordship to look upon it exactly in the same way. Leaving residuum in is a great disadvantage. It is a great disadvantage for very important thermo-dynamic reasons. If you want to make a gas engine work economically, you must start with your gas at the moment of combustion as cool as possible. It makes a very great difference what range of temperature you act through, and if you can only get your gas cool at the moment that you ignite, you get far greater efficiency than if it is heated. Now, if you leave that residuum in it heats your gas and you lose so much efficiency. Of course, if you sweep it out, you must have a properly diluted charge, so that there may be enough inert gas. Then, not only is the residuum not an advantage, but the residuum was always left there. You never could, with the clearance space of gas engines, get residuum out. Then, he was told, "not in a notable quantity!" All he could say was, that in the Lenoir engine he should prove that there was about 20 per cent. of the charge that was residuum. In fact, so conscious was Lenoir that he could not get rid of his residuum that he actually introduced some air in order to neutralise its chemical action—not its action as a recipient of heat, because putting in air only increased the amount of inert gas which would act as a recipient of heat, but because he thought the presence of carbonic acid prevented combustion chemically. Million cannot help having residuum. He wants his space, and he is obliged to put up with residuum. If that was a merit, he had done it. He describes as clearly as possible letting in a compressed charge; and he should show his lordship that the suggestion that it was an uncompressed charge has no justification at all; but he actually lets it into the space which was necessarily filled with residuum. There is no merit in it. We should sooner get rid of it. If there was merit, it certainly, after Million, cannot be called novel, and as to the novel arrangement by which it is let in, all he could say is it is Million's, pure and simple.

Mr. JUSTICE PEARSON: I may say that you have confirmed me in an idea which I have had for a great many years, that all patents are bad.

Mr. ASTON: I have heard your lordship say so on former occasions.

Mr. MOULTON: I intend to prove that, if all patents are bad, this is the very worst.

(*To be continued.*)

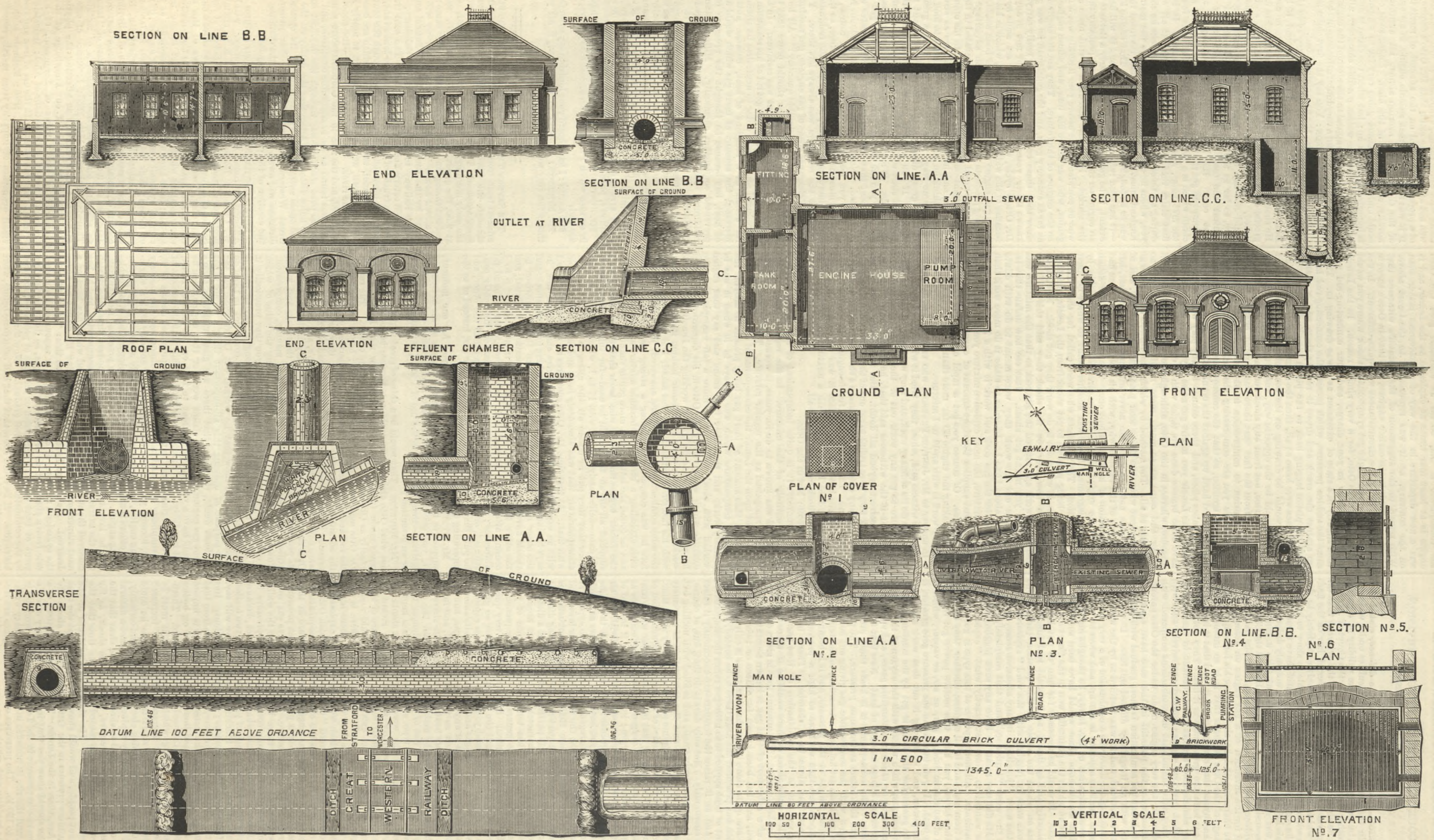
THE SEVERN TUNNEL.—On Saturday last, the 9th inst., the first mineral train from South Wales successfully passed from Aberdare through the Severn Tunnel to Bristol and on to Salisbury and Southampton. The steam coal, cut in the Aberdare colliery in the early morning, was placed in the trucks, and, leaving Aberdare at 9.50, the goods train reached Bristol at 2.30, Salisbury at 6.45, and Southampton between eight and nine the same night, a journey of eleven hours. The Great Western Railway will now carry coal direct by the South Wales and Severn Tunnel and South Wales Union Railway to Bristol and on to Salisbury, and thence by South-Western line to Southampton. The coal train consisted of fourteen trucks of 10 tons each, and two brake vans, with engine. It took just nineteen minutes to pass through the four miles and one-third of tunnel, two and a-quarter of which are beneath the rapidly flowing Severn, at a depth of from 45ft. to nearly 100ft. below the bed of the river. To the lowest point—the shoots—the gradient is 1 in 90, and the rise to the Gloucestershire side 1 in 100. The road was found to be in admirable condition, and the atmosphere was so pure that half-way through the daylight could be seen at two miles distance. Altogether the outlay on the Severn Tunnel and these extra works in consequence of its opening will cost the Great Western Railway £2,000,000. For passenger traffic the directors will await the completion of the doubling of the line and the erection of the powerful ventilating fan.

ROYAL INSTITUTION.—A course of four lectures on "Metals, as Affected by Small Quantities of Impurity," will be delivered by W. Chandler Roberts-Austen, Esq., F.R.S., chemist of the Mint, professor of metallurgy in the Normal School of Science and Royal School of Mines, on the following days, at three o'clock:—Lecture I. Thursday, January 28th, 1886: Views of the early Egyptian, Greek, and Arabian chemists relative to the constitution of metals; circumstances which favoured the belief in the transmutation of metals; facts known to the mediæval chemists as to the influence exerted by small quantities of impurity on the physical properties of metals; their importance in relation to modern metallurgical practice. Lecture II. Thursday, February 4th, 1886: The influence of the presence of small quantities of alloying metal on the colours of metals and alloys; illustrations borrowed chiefly from Japanese art metal-work; the importance of "traces" of impurity as affecting certain physical constants of metals. Lecture III. Thursday, February 11th, 1886: Influence of small quantities of carbon and other elements as affecting the physical constants of iron; historical sketch of our knowledge of the hardening and tempering of steel; views of Bergmann, of Faraday, and of Graham; recent investigations of Abel; industrial importance of "traces" in connection with the use of iron and steel. Lecture IV. Thursday, February 18th, 1886: Methods adopted for removing small quantities of impurity from metals, especially in the cases of iron, copper, lead and gold.

SEWERAGE OF STRATFORD-ON-AVON.—BUILDINGS AND OUTFLOW CULVERT.

MR. E. PRITCHARD, M.I.C.E., ENGINEER.

(*For description see page 46.*)



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THE ENGINEER, January 15th, 1886.

TO CORRESPONDENTS.

Registered Telegraphic Address—"ENGINEER NEWSPAPER, LONDON."

*** *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.*

TASMANIAN.—*There is no certain information in existence. A message has first to be sent over the nerve from the injured part, and then a return or reflex impulse, which makes the part affected jump or take other action. So far as is known, such messages are transmitted at about the rate of* 60*ft. per second.*

A. W. L.—*The Cornwall, an outside cylinder engine of the Lady of the Lake type, is, we believe, still running on the London and North-Western Railway with* 9*ft. wheels. If she has been taken off the road some of our Crewe readers will correct us no doubt. The broad gauge engines on the Great Western Railway have* 8*ft. wheels; so have Mr. Stirling's outside cylinder engines on the Great Northern. These are the largest drivers in use anywhere.*

ENGINEERS ABROAD.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers inform me if there are any openings for mechanical engineers in connection with South American railways? I should also desire similar information with regard to proposed railway operations in Burmah.

R. M.

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Friday, Jan. 15th, at 7.30 p.m.: Students' meeting. Paper to be read, "A Graphic Method of Determining the Flow of Water in Pipes," by Rudolph E. von Lengerke, Stud. Inst. C.E. Dr. Pole, F.R.SS. L. and E., hon. secretary, in the chair. Tuesday, Jan. 19th, at 8 p.m.: Ordinary meeting. Paper to be discussed, "On Gas Producers," by Mr. Fred. Jno. Rowan. And paper to be read, time permitting, "The Injurious Effect of a Blue Heat on Steel and Iron," by Mr. C. E. Stromeyer, Assoc. M. Inst. C.E.

CHEMICAL SOCIETY.—Thursday, Jan. 21st, at 8 p.m.: Papers to be read: "The Influence of Silicon on the Properties of Cast Iron," Part III., by Mr. Thomas Turner. "The Chemical Action of Pure Cultivations of Bacterium Aceti," by Mr. Adrian J. Brown. "On the Separation and Estimation of Zirconium," and "Notes on the Analysis of Koppite," by Dr. G. H. Bailey. "The Mono-bromophthalic Acids," by Mr. E. Stallard "Mercury Sulphites and the Constitution of Sulphites," by Dr. Divers and Mr. T. Shimidzu. "Benzoylacetic Acid and some of its Derivatives," by Dr. W. H. Perkin, jun., and Mr. A. Calman.

THE PARKES MUSEUM OF HYGIENE.—Wednesday, Jan. 20th, at 8 p.m.: Professor T. Roger Smith, F.R.I.B.A., "On a Damp House." Sir Joseph Fayrer, F.R.S., in the chair. Thursday, Jan. 21st, at 8 p.m.: A lecture will be delivered by Mr. R. F. Grantham "On the Working of the Separate Sewage Systems." Professor W. H. Corfield, M.A., M.D., in the chair.

SOCIETY OF ARTS, John-street, Adelphi, London, W.C.—Monday, Jan. 18th, at 8 p.m.: Cantor Lectures. "Friction," by Professor H. S. Hele Shaw. Lecture I. The friction of solids. Wednesday, Jan. 20th, at 8 p.m.: Seventh ordinary meeting. "Results of Experiments on Mechanical Motors for Tramways made by the Commission at the Antwerp Exhibition," by Captain Douglas Galton, C.B., D.C.L., F.R.S. Mr. W. Anderson, M. Inst. C.E., will preside. Friday, Jan. 22nd, at 8 p.m.: Indian Section. "Burma: the Eastern Country and the Race of the Brahmas," by Mr. J. George Scott (Shway Yoe). The Hon. Sir Ashley Eden, K.C.S.I., will preside.

DEATH.

On the 11th Nov., 1885, Mr. GEORGE RANSOM, Civil Engineer, accidentally killed by a light engine at Vipos Station, North Central Railway, Tucuman, Argentine Republic.

CORRECTION.—We regret very much the statement made in the letter of our North of England correspondent which appeared in our last impression, to the effect that Messrs. G. E. Casebourne and Co., of West Hartlepool, had failed. It appears that a large foreign customer of that firm had stopped payment, but we are informed that Messrs. Casebourne and Co., beyond being sufferers by the loss, are not affected in their business, and that the steamship to which reference was made was not stopped by a creditor, but by Messrs. Casebourne themselves. We repeat our expression of regret that the passage in question should have appeared in our columns.

THE ENGINEER.

JANUARY 15, 1886.

FORCED DRAUGHT.

MR. HOWDEN, as will be seen from his letter on another page, thinks that we have done him—or rather his system—an injustice in our annual article. Nothing could be further from our intention, and we think that on examination it will be found that Mr. Howden substantially confirms what we have said, which is simply that during the past year his method of burning fuel with a forced draught had not made much progress. We are glad to find Mr. Howden writing on the subject, and we hope that he will supply some practical information concerning the results he has obtained during the last year with the boiler he has fitted. Not the least interesting portion of his letter will be found near its end. It will be seen that he doubts whether any boiler can be got to stand for more than a few hours the strain put on its furnaces by generating steam at the rate of 17 indicated horse-power per square foot in a closed stokehole. What closing the stokehole has to do with the matter we must ask Mr. Howden to explain. Closed stokehole or not, the question raised is very important. Much reliance is being placed in our Navy on forced draught; and if it is found that its use may render a ship helpless in her time of greatest need, it can of course only be regarded as a delusion and a snare. Nothing quite satisfactory can be learned on the subject except by way of direct experiment; but it is possible to reason from one set of data to another, and thus estimate with some degree of accuracy whether fears on this point are or are not well grounded.

If we assume that engines in a man-of-war of large power are being run at full speed, we shall not be far from the truth if we take the consumption of fuel at 3 lb. per indicated horse-power per hour. The weight of coal burned will be $3 \times 17 = 51$ lb. per square foot per hour. This is by no means an extravagant quantity. In torpedo boats nearly three times as much is put into the furnace. It is true that it is not all burned, the ejection of cinders from the funnels representing a great deal of coal; but making every allowance, it is certain that the rate of combustion is double that attained in men-of-war. But torpedo boats can run at full speed for as much as six hours at a time, and their boilers are none the worse. A locomotive burning 30 lb. of coal per mile, and running at fifty miles an hour, will with a grate surface of 20 square feet, burn 75 lb. per square foot. This, again, is much in excess of the rate concerning which Mr. Howden has his fears. The torpedo boiler is of the locomotive type; so that both the examples we have quoted refer to a class of boiler different from that used in the Navy and merchant service. If Mr. Howden is right, then it is the stokehole that is wrong, not the system. We do not very clearly understand what it is that our correspondent thinks will take place. What really occurs in such ships as the Rodney is that a great deal of heat goes up the chimney when the fires are urged, because the tubes are too short and too large in diameter for economy. In the case of torpedo boats, runs at full speed will soon be brought to a conclusion, if there is a trace of iron in the coal, by the formation of slag rings on the furnace tube plate, very much resembling the ordinary india-rubber umbrella ring. These rings quickly reduce the calorimeter of the orifices of the tube, and destroy the draught. They have to be removed with a scraper and a wire brush, which cannot be done while the furnace is in full blast. Whether similar rings will or will not form in marine boilers with the flues returned over the furnaces, we cannot say with certainty; but we believe that no trouble will be experienced from this cause. It may be well before leaving this branch of the subject to call attention to a slight inaccuracy in Mr. Sennett's excellent book on the marine engine, a new edition of which has been recently published. He reproduces there the old and well-worn statement that flame will not traverse a tube such as those used in steam boilers. This is only true with limitations. It is entirely a question of draught; and we can say, as the result of our own investigations, often repeated, that flame can be made to fill a tube 2½in. in diameter and 6ft. long with great ease with a vacuum of less than 2in. of water in the smoke-box. Mr. Wye Williams made experiments intended to prove that the end of a tube near the smoke-box was useless or nearly so. The belief has extended that his statements are correct, and a great deal of money has been spent in trying to apply the short tube principle to locomotives, and with the worst results. Williams and Stephenson—who made similar experiments—did not use a sharp draught. They burned gas in a fire-box. The sharper the draught the more does the efficiency of tube surface increase within certain limits; and if Mr. Howden will try the experiment of partitioning off a tubular boiler into sections, and will then employ forced draughts of various powers, he will obtain, unless we are much mistaken, figures which will make him very glad. There is one serious danger in the use of forced draught, namely, the burning of the fire bars. Some years ago the six hours' full power run of H.M.S. Iris was brought to an abrupt conclusion by the coming down of about half her grates. The cast iron bars were melted down into the ash-pits, and in this case only jets in the chimney were employed to force the draught.

It seems difficult to prove that working with a forced draught can be economical; yet, after all, everything depends on what is meant by the words "forced draught." In point of fact, steam boilers are always worked with a forced draught. We may employ the pull of a tall chimney, or the blast pipe of a locomotive, or a fan—as in a torpedo boat—but each and all drive air through the furnace bars in greater quantity than it would go without them. If the air is driven through too quickly, great quantities of unburnt fuel are carried up the chimney, and the products of combustion are hurried at such speed through the tubes or flues that there is no time left for the water to absorb the heat from the gases. Here we have distinct sources of waste. On the other hand, with forced combustion the fire becomes intensely hot. The chances of the evolution of CO, instead of CO_2, are diminished; more of the heat appears in the radiant form, and the furnace becomes more efficient. There are apparently more facilities for warming the air required for combustion, because it is more under control when supplied by a fan than when it is furnished promiscuously from the great atmospheric ocean. Nothing just now affords more promise of economy in the generation of steam than warming the air supplied for combustion, the warming to be effected by the waste heat in the chimney or smoke-box. A pound of coal burned with 20 lb. of air raises that air through at least 300 deg. To begin with it probably raises it to nearly eight or ten times that temperature; but the difference is absorbed by the water in the boiler, and we have only to do with the initial and final temperatures—say 60 deg. and 360 deg. Of the whole heat in the pound of coal, $20 \times 300 \times \cdot 23 = 1380$ units are wasted up the chimney, or enough in round numbers to produce a pound of steam. Put in another way we waste from 10 to 15 per cent. of our coal by supplying our furnaces with cold air. It remains to be seen whether any tangible saving can really be effected by heating the air employed in combustion. We do not mean that this demands experimental proof—that has often been supplied. What is needed now is that form of practical demonstration which takes into account everything which ought to be put on the debit side of the ledger, such as first cost, and wear and tear of apparatus. The whole question of forced draught is, as far as the mercantile marine is concerned, one of money, and Mr. Howden will do good service if he will supply us with a statement of the pecuniary results of the use of his invention during the last twelve months, as shown by Mr. Scrutton's books. This is the crucial point, and if shipowners can be satisfied concerning it, Mr. Howden will not, we think, lack orders.

THE DEVELOPMENT OF RAILWAYS IN CHINA.

THERE is no commercial and social question of the present hour that is of more urgent importance to our engineers and manufacturers than that of the "fresh fields and pastures new" in which an extension, if not an initiation, of railway enterprise may be looked for. So far as Europe is concerned, our railway pioneers and contractors have conquered time and space almost as effectually as Alexander did the ancient world, so that there is comparatively little left to accomplish in the future. It is largely, but to a less extent, the same in the United States. The future of American railways is little likely to proceed at the same rate as the past has done, seeing that in the Northern and Eastern States most of the ground is now covered, so far, at least, as main trunk lines are concerned. Canada is far from being equally well furnished with the means of transport, but with a population of only about five millions to an area of nearly 3½ millions of square miles, it is scarcely to be expected that Canadian railway enterprise will proceed with very rapid strides, for the railways must follow and not precede the population and trade that are to support them, if and when they are to be maintained on strictly commercial principles. Our Australian Colonies are in much the same position as the Dominion, seeing that in 1881 they contained, unitedly, a population of under three millions for an area of over three millions of square miles. There is some likelihood that in both of these cases the railways to be constructed in the future may somewhat forge ahead of the reasonable probabilities of remunerative traffic. At the present time efforts are being made to provide railway extensions in South Australia out of all proportion to the actual traffic or numerical strength of the population, which only numbers some 35,000, for an area of close on a million square miles. But it would be too much to expect that this will be done on a large scale. Notwithstanding the unmistakeable advantages conferred by railways in the way of attracting population and developing trade, there must generally be some substantial reason to expect dividends within a reasonable time, or the railways will not be made; and this consideration applies equally to capital raised by private enterprise on a strictly commercial basis, and to capital provided either by local authorities or by a central executive Government.

Impatient of the slow growth of railway enterprise in our own colonies, and shut out by hostile tariffs from

European, as well as, in great part, from American markets, it is natural that our engineers, manufacturers, and others interested in such matters should cast wistful glances towards those Asiatic countries where a fertile soil and a teeming population promise to yield immediately adequate results. India has already been supplied with a network of main trunk lines, but a good deal still remains to be done before the really urgent wants of the country are supplied. But the poverty of India is such that it would be "laying the last straw on the camel's back" to attempt, as in Canada and our Australian colonies, to raise money by increased taxation, even for so unequivocal a gain as railway facilities; and as it would be difficult otherwise to borrow the money required from Indian sources—a point upon which the Select Committee on East Indian Railways, in their report, dated 18th July, 1884, laid much stress—the extension of the system in India is likely to be comparatively slow. There remains, however, the territories of the Shan States, Upper and Lower Burmah, the Congo and other States in Africa, and last, but not least, the Chinese Empire, all awaiting the application of British capital, enterprise, and intelligence to bring them into accord with the rest of mankind, in reference to the possession of transportation facilities.

At the present time a certain vague and undefinable expectancy appears to hang about the railway prospects of the last-named country. The reason is not far to seek. China is not, like Central Asia generally, subject to the control of a Colossus greater than herself. With "all the world before them where to choose," the Celestials are at liberty to accept or reject Western overtures for railway development; to accord a preference to English or German proposals; to buy in any European market that their own partiality or the intrigues and blandishments of others may dispose them to prefer. Unprovided with the resources for supplying her own needs in this direction, China, when she has once fairly cast in her lot with the rest of the world in reference to railway facilities, must seek for the requisite materials of construction in other countries. Recent events have proved that England will not be permitted, without a struggle, to carry off any large share of the spoil. The time has gone by when the English merchants and manufacturers could carry things with a high hand, and practically dictate their own terms in furnishing the materials for railway construction to other countries. The game was a profitable one so long as it lasted. Other countries have realised this fact as well as ourselves, and are now determined to contest with us, "brow to brow," all the contracts or concessions that are worth looking after in foreign countries. So far as China in particular is concerned, both Germany and America have already been nibbling at the bait; and considering that the manufacturers of both these countries enjoy, in their own protected markets, an artificially high price for their products, they can the better afford to throw on neutral markets, at a relatively low rate, the surplus output of their forges, factories, and mills. Englishmen may therefore depend upon it that if they are to be to the front at all in the forthcoming industrial campaign, they cannot afford to leave any opportunities or facilities unimproved. It has not, so far, however, been settled that China has as yet been educated up to the point of being prepared to sanction and afford facilities for the construction of railways. There are several causes that operate in China to environ this matter with difficulties that are not equally applicable to other countries. The Chinese are naturally a very conservative people. They believe that they have a civilisation more advanced in its way, as it certainly is of greater antiquity, than that of Europe. They are exclusive and reserved, and the "men of light and leading" in the country seek to avoid, rather than to cultivate, contact with European manners and methods. There is, moreover, the serious difficulty of religious scruples and sentiments. The worship of their ancestors being the predominating feature of their religion, they have a superstitious veneration for their places of burial, and as the number of such places is legion, it would be next to impossible to scheme a line of railway that would not be liable over and over again to offend their susceptibilities by the absorption and desecration of burial-grounds. Nevertheless, it is believed by those who have most carefully looked into the matter that this difficulty is not insuperable. It certainly did not prove so in the case of the short line of railway that was constructed by Mr. John Dixon, at the instance of Messrs. Jardine, Matheson, and Co., of Shanghai, in 1876. The promoters of this line were able to purchase the land right out, although in the absence of compulsory powers it was necessarily a costly proceeding. The Chinese offered no obstacles to the progress of the work. On the contrary, they received the first engine with enthusiasm, and the railway was in itself highly successful, being freely used by all classes of the community. It has been stated, and is in many quarters still believed, that the experimental line was broken up because of an unconquerable aversion to the system on the part of the Chinese Government. Such is really not the case. The unfortunate murder of Mr. Margary afforded to the Chinese, in the course of the dispute with the British Government which followed, an opportunity of alleging that the railway was a grievance, and that the upshot of the matter was that the Chinese authorities agreed to purchase the line, for which they paid £78,000 as the full amount of expenditure incurred by the company of promoters. The Governor of Nankin, in whose hands the matter was now left, was annoyed at having to purchase the railway on behalf of his Government against his own will, and, determined at all cost to get rid of it, acceded to a proposal made by the Governor of Formosa, that the railway and all its belongings should be sent to that island, whither the whole plant was accordingly shipped; but, in the absence of skilled engineers, the plant has never been made of use. It is perfectly true that the history of this experimental line has not been altogether encouraging. At the same time, it sufficed to show that the Chinese, as a people, were not against the system; that as booking-clerks, firemen, and platelayers, the natives discharged their duties with readiness and efficiency, and that the necessary land and all other requirements may be obtained at a price, which need not necessarily be as high as that paid in the case of the Shanghai and Woosung line. One of the greatest difficulties, if not absolutely the greatest, will be that of ways and means. China is not generally a rich country. Several loans have already been raised in London on behalf of the Chinese Government, but at a rather high rate of interest. It is probable that little difficulty would be found in repeating this experience, especially if it were understood, and provided that, subject to certain clearly-defined provisions safeguarding the rights and interests of the subscribers, the money should be applied exclusively to railway purposes. Much, however, will require to be done before this stage of the matter is reached. English capitalists are scarcely likely to subscribe to an undertaking which appears, as in the case of the Shanghai and Woosung line, to be entirely at the mercy of a capricious local mandarin. They would also require reasonable assurances that powers would be afforded for the compulsory purchase of land, otherwise serious difficulties would constantly be cropping up. As to the financial prospects of Chinese railways, no one can doubt that they are exceedingly good. It is not necessary to believe—as is often asserted, but as Sir Richard Temple and other authorities dispute—that the Empire has a population of over 400 millions, in order to comprehend this fact. Within recent years the Chinese have shown a disposition to develope the great natural resources of their country. In several districts they have undertaken the development of their enormous coal resources on European methods. The latest report from her Majesty's Consul at Newchwang states that "the Chinese authorities are about to open and work with foreign machinery some coal and iron mines just discovered, about two miles from Talienwan Bay—the coal, as analysed at Shanghai, containing 88·2 per cent. of carbon, and specimens of the iron ore showing 51·5 and 45·5 of metal respectively. Tea, sugar, pineapple, cloth, pewter-ware, iron-ware, tin-ware, cotton and woollen fabrics are also being increasingly cultivated, and made, and would each, no doubt, with railway facilities, undergo a great expansion.

The recent course of railway enterprise in Japan is calculated to throw some light upon the subject of which we have just been speaking. When the construction of railways for the Mikado's Empire was first suggested, the proposal met with so great an opposition from the large party that had always endeavoured to impede any progress towards Western civilisation, that it was not until 1870 that a practical beginning was made with the construction of a line, eighteen miles in length, designed to connect Tôkiô with Yokohama. The cost of this line was £34,263 per mile, about three times the average cost of American railways, and a higher average than that of any country in Europe except our own. There is nothing to show how this very heavy outlay was necessitated, as the line passes over a comparatively level country, and the engineering difficulties were few. The passenger traffic and the gross and net receipts from this line have increased enormously since the opening in 1872. In the year 1873, the number of passengers using the line was $1\frac{1}{4}$ millions; in 1883 it was $2\frac{1}{4}$ millions. The total receipts rose from 395,000 yen in 1873 to 556,000 yen in 1883—an increase of over 40 per cent. In 1873 the working expenses were 30 per cent. of the gross receipts; in 1882 they had risen to 50 per cent. of the total receipts. The success of the first Japanese railway soon encouraged the formation of others, and in 1874 the Government opened a line between Kobé and Osaka, 22 miles in length, at an average cost of £33,970 per mile. In 1876 another line was opened from Osaka to Kioto, 27 miles long, and costing an average of £20,875 per mile; while three years later still a line was opened between Kioto and Otsu, a distance of $11\frac{1}{4}$ miles, at a total cost of £157,227, or rather over £14,000 per mile. The next important railway undertaking was that of the Tsuruga and Ogaki line, 49 miles long, which was constructed in 1880, at a total cost of £550,000, or £11,224 per mile; and this was followed in the same year by the Temiya-Sapporo and Poronai line, 56 miles long, and constructed at a total cost of £204,742, or rather under £3700 per mile. The longest line hitherto constructed in Japan is that of the Uyeno and Takasaki section of the Japan railways, $68\frac{1}{4}$ miles in length, which was opened to Takasaki on May 1st, 1884. Besides these lines there are several important railways now in progress, including one 213 miles in length, intended to connect Takasaki with Ogaki; the Utsunomiya line, 50 miles in length, which will open up the celebrated district of Nikko, with its ancient and beautiful temples; the Utsunomiya and Awomori line, 398 miles in length, which will afford communication with the extreme North, as well as several smaller lines. Altogether there are now 265 miles of railway opened in Japan, 271 miles in course of construction, and 543 projected. A great deal of the money required for these lines has been raised by the Japanese Government in Europe, the principal loan being issued at a nominal price of 90 yen per bond of 100 yen, and bearing 7 per cent. interest.

There are so many points of contact between China and Japan that the analogy supplied by the one may be in highest degree serviceable in measuring the prospects that lie before the other. Having seen how readily the Japanese have prosecuted railway development when once they had realised the advantages which it afforded, we may safely infer that it will be much the same in the case of China, but most probably with even greater energy, and on a much larger scale.. In the case of the Japanese railways, England has supplied nearly all the rolling stock and permanent way, with the exception of a number of carriages and wagons manufactured at Shinbashi, where the Japanese established workshops very shortly after the opening of the Tôkiô and Yokohama line. The decrement in the cost of the later as compared with the earlier lines laid down in Japan is very remarkable. It is largely to be explained by the fact that between 1870 and 1874, when the first lines were constructed, all materials of construction were abnormally high, and the stations, &c., on the earlier lines were also built on a more costly scale. It may be added that a number of the locomotives used on the Japanese railways are of American construction.

ROAD REPAIRS.

A LETTER but recently appeared in the *Times* commenting upon the method of repairing roads under what is known as the Macadam system. With the advice given in that letter as to the ill-effect of using broken stone of undue size we most fully agree; but with the recommendation put forward in it to adopt a system of patching roads, all those experienced with the repair of roads must, we think, disagree. In fact, the author of the letter referred to appears to wholly ignore the introduction of the steam road roller, and the vast improvement in the maintenance of our highways to which the use of that most efficient instrument has led. Had Macadam lived since its invention, we do not doubt his method of repairing roads would have been greatly modified by him. To revert to that method pure and simple, as is advocated by the writer of the letter referred to, is to take a very serious step backwards. All those to whom road repairs are entrusted know how deteriorating are the effects of any plan of patching roads. It illustrates the truth of the old saying as to the evil of patching old cloth with new. Although every care may be taken, metal, when laid in worn places, is the fruitful cause of injury to the general surface of the road. It hastens, by causing an impediment to free drainage, the destruction of that portion of the road surface not subjected to treatment. It, besides, causes a slip and a side grinding motion of passing wheels, which also greatly tends to the same effect. Since the introduction of steam road rolling it has been found to be the best economy to pick up the whole surface of a road, thoroughly to level its inequalities, and then to apply a coating of new metal over the entire width and well roll it. Road repairs so effected are in the long run far cheaper, and insure much more regularity in the wear of the road, than does any system, however cheap it may be in first cost, of merely filling in worn places with metal and allowing it to be worked in by traffic. We need scarcely allude to the cruelty involved to the animals employed in draught which such a method as the last involves, for it must be patent to all who have watched their efforts to drag a heavy load over unrolled metal. To leave the settlement of this to such an agency is to ensure the destruction of much of the metal before it becomes consolidated, and it is therefore a fruitful source of waste. Nor can we quite agree with the remarks made in the letter as to the uselessness of binding the metal with sand or gravel. The employment of these tend to the comfort of horses working on newly-made roads, and if used sparingly do some good in binding the stones. To leave this, as suggested by the writer, to the gradual accumulation of detritus of the metal itself is but to wait until deterioration of the surface has commenced; nor can the mere dust so formed ever possess the binding capacity, or that of rendering the surface waterproof, which the use of a small quantity of gravel containing a limited proportion of clay will effect. While, therefore, admitting the advice given to break the metal smaller than is generally done to be sound, we should deprecate the return to any principle of road repair which ignores the progress made in the application to it of new agencies which have sprung into existence since Macadam wrote.

THE INSTITUTION OF MECHANICAL ENGINEERS.

A MATTER which has nothing personal in it in the government of the Institution is attracting some attention as one of principle, and seems to call for some explanation further than that offered in the circulars just sent out concerning the election which is to take place at the meeting of the 4th February next. The number of names on the ballot list is only that which has to be returned, so that members must agree with that list, or not vote, or must run the risk, if they strike out any name or names, of returning an insufficient number for a Council. The explanation offered is that no names were added by members to the nomination list sent out last October. After the resignation of a large number of the Council, in consequence of the ill-advised action of a small section of the members, a number of members of Council had to be appointed by the remaining Council in accordance with bye-law 28. These members of Council so appointed retire but are eligible for re-election, and to explain the matter above mentioned, the circular states:—"It has been usual for the Council to nominate more names than sufficient to fill the vacant seats; but considering the shortness of the period during which, owing to the operation of the article referred to, the eleven gentlemen will have held office, the rest of the Council propose to limit the nominations by the Council on the present occasion to the above names, with the one additional name of Mr. Thomas W. Worsdell, Gateshead, in place of Mr. Francis C. Marshall, who has since resigned. In this course the Council believe they are acting in accordance with the wishes of the members generally." Probably no one wishes to make any change in the names offered by the Council, but the practice of giving only that number which must be elected is a bad one, and the Council have added to the objection which attaches to this by including in the list of nine members which are to be elected, the name of one who has died since the nomination of October, and stating in explanation that, "The decease of Mr. Bennett subsequently to his nomination at the last general meeting for re-election as a member of Council will constitute a casual vacancy to be dealt with by the Council after the present election, in accordance with No. 28 of the Articles of Association." It would certainly have been more "in accordance with the wishes of the members generally" if this mode of filling up the Council ranks had not in this case been resorted to. There could have been no objection to the Council suggesting a name or names, so as to prevent the absurdity of voting for a member deceased. That no names were added by the members to the list last sent out does not show anything more than that they thoroughly understand the uselessness of adding names themselves, inasmuch as if every member acted without reference to the additions made by others, as almost all would do, no such additions could be of the least effect, because almost all would be voting for different men. The Council list is, therefore, bound to be the list of elected. Only eight members can be returned according to circulars now sent out. If any are struck out, the Council will again have to appoint several of its own members.

THE DANGER OF OVERHEAD WIRES.

THE heavy snowstorm of last week will probably be found to have done much towards remedying a remarkable omission by the Committee of last session on Telephone and Telegraph Wires, whose proceedings we reported at some length. Alarmingly soon after the snow fall commenced, overhead wires began to break, and in a few hours a very large number in all directions, in the metropolis at all events, had fallen. Little injury was done to persons, but that was due to good fortune, and to the fact that the bulk of the wires that fell, came down before the busiest hours of the day arrived. The accidents—if accidents they should be called—occurred, and this experience amply justifies the public in regarding each particular wire stretched in mid air as a veritable Damocles' sword, by which anyone may be decapitated at any moment, as the unfortunate omnibus-driver was, a year or two ago, in Westminster. During the inquiry last session a large amount of evidence was given respecting ærial wires, and although the mishaps cited were comparatively few, it was made clear that these wires were full of danger even when kept in good condition—and there are still existing hundreds of old, rotten, and abandoned wires. These were no doubt the first to fall last week, but the strain caused by snow is sufficient to snap the strongest wire, especially if snow follows snow and partial thaw. The Committee reported that in their opinion the danger from overhead wires had been greatly exaggerated; but on this point it should be remembered that what was a slight risk a few years ago, when the number of wires was very limited, has been vastly increased by the enormous extension of telephone wires. And further, during the greatest development of the telephone, there had been no very heavy fall of snow in London, such as that ten days ago. It was stated in evidence that there were then ten times as many overhead wires as there were a few years ago; and since then there have been further additions, no legislation having yet followed upon the Committee's report. A few figures laid before the Committee will best illustrate the matter. An official return relating to the City alone showed that there were 320 wires running across Moorgate-street, 320 across Coleman-street, 240 across Leadenhall-street, in a distance of 1414ft.; 81 cables and 408 wires across Queen Victoria-street, in 2000ft.; 2 cables and 142 wires across Ludgate-circus; 6 cables and 74 wires across Queen-street, leading to the Guildhall, in 520ft.; 7 cables and 360 wires across Cannon-street; while the average in the City was calculated at 1000 wires per mile! These are surely alarming facts, without considering the certain increase in the past year, and in coming years—unless Parliament insists upon the Telephone Company running the wires underground, as the Post-office largely does. The breakage of wires last week elicited prompt complaints, and some members of the Committee have taken part in the correspondence. Mr. George Russell, who was chairman of the Committee, made a valuable contribution to the discussion. On the conclusion of the inquiry he submitted a draft report, in which, while observing that the danger from ærial wires had been greatly exaggerated, he proposed to report to the House that "at the same time the Committee are of opinion that the probable development of the telephonic system makes it desirable that there should be some change in the law relating to control over wires, with a view to their better supervision;" that, in order not to hamper the extension of the telephone, the erection of overhead wires should be continued at any rate to some extent, and subject to proper supervision, "but overhead cables should not be permitted," and where more than ten wires are run along a line, the local authority should have power to compel them to be taken underground. "He likewise suggested the recommendation that no power to pass or keep wires over private property without the consent of the owner or occupier should be given to any company or private person." These proposals were not very severe, and would certainly have been valuable, but the Committee rejected them, as a whole, by a narrow majority, and adopted only the declaration that the danger had been exaggerated, and the suggestion of a change in the law relating to control. This decision, in Mr. Russell's view, was inconsistent with the interests of public safety and the rights of private property; "and Mr. Firth another member of the Committee, says the minority of the Committee were in favour of much more stringent regulations with respect to overhead wires." In view of all the circumstances it is strange that the Committee so lightly treated this matter; but the recent experience will probably lead to some more effective result when the natural sequel to the Committee's inquiry comes to be worked out in the House of Commons.

IRON STOCKS AND PRODUCTION.

ONE of the most remarkable features in the iron trade is the increase in the stocks of pig iron, but very few who take notice of the fact carry it on to the proper comparison—that with the total production. If we look at the figures for the last five years we shall have a better idea of the importance of the comparison. Production for the United Kingdom was for the year 1881 about 8,370,000 tons, and stocks a little over 1,876,000 tons, or roughly, less than a sixth of the total make. In 1882 production and stocks both advanced, though not very greatly, and the proportion was not very materially affected. In 1883 there was a very slight diminution in the total production, but the stocks rose, and the proportion showed stocks nearly to a fifth of the output. In 1884 the output fell and the stocks rose, so that there was held not much less than a fourth of the year's make. Finally, in the past year there has been a production which for the year is put at 7,450,000 tons in one of the best estimates, whilst the stocks were over 2,500,000 tons; and we now hold more than a third of the year's output. It is quite probable that these stocks in stores and in the hands of the makers represent a larger proportion of the total tonnage held—that is to say, that it is likely that the amount in the hands of consumers will be less; but still, the fact that we now hold over four months' production of pig iron is one which is rather startling. If there were any rapid rise in the price of iron these stocks of crude iron would speedily vanish, but their largeness is one of the factors in preventing the increase, because consumers know that there is a large reservoir of stock to draw upon, and thus they work from hand to mouth as much as possible. Whether the large increase in the stocks will lead to a reduction of the production cannot be said as yet, but its tendency will be in that direction; and it is just as well to have some early official statement as to those stocks. We shall not get this yet; but it would be a matter of congratulation to the iron and steel trades if earlier returns could be given.

THE OSNEY BRIDGE, OXFORD.

A BRIDGE which occasionally gives a little trouble may be one which avoids a good deal of litigation. The fall of the Osney Bridge at Oxford is an illustration, and will afford a pretty quarrel. The Oxford Local Board repudiate their responsibility to repair or rebuild the structure, the contention being that "the Local Board, not being a county, cannot be liable to repair ancient bridges, unless by reason of tenure, or prescription, or Act of Parliament." The authorities in the county have also submitted a case to counsel. The Chairman of the Court of Quarter Sessions and the Clerk of the Peace have come to the conclusion that no liability attaches to the county to maintain bridges situate within the boundaries of the limits of the Oxford Local Board. Between the two bodies the matter will afford some legal entertainment, but the *Oxford Chronicle* says the difficult question will be fought out in a friendly spirit. The question is further complicated by another, namely, as to whether the recent works of the Thames Valley Drainage Commissioners and the Thames Conservators was not the cause of the downfall by undermining the pier. The Oxford Local Board have, however, accepted a tender from Mr. Bossom, of Oxford, to erect for £477 a temporary timber bridge according to plans prepared by Mr. W. H. White, M. Inst. C.E., engineer to the Board. This work has been undertaken under an arrangement between the Board and the County Bridge Committee, the cost to be ultimately borne by whichever of the two bodies named is proved to have been chargeable with the maintenance of Osney Bridge; and the undertaking is also "without prejudice" to the claim either party may have against the river and drainage authorities whose works are considered to have caused the fall of the bridge. The *Chronicle* naïvely says, "as it is probable the temporary bridge may have to stand a long time, it will be of a substantial character."

OUR ROOFS AND THE SNOW.

THE heavy snowstorm which has recently visited us is likely to produce results not to be generally anticipated when the last visitation of the kind overtook us in 1881, and it will be as well to caution our readers who may find themselves subjected to them. Since that date a very large number of the new houses which have been built in the suburbs of London have been completed with flat roofs covered with zinc. These were comparatively unknown a few years ago, and those who now dwell under them may find, should a sudden thaw set in, that this form of roofing possesses, with many advantages, other properties of quite a contrary character. It need hardly be pointed out that a flat roof will accumulate a heavy burden of snow which would fall off and disappear from a sloping roof, and when a thaw comes it may be found that the discharge pipes, themselves probably partly frozen up, will be inadequate to carry off the heavy flow of water. It is likely that the flashings of the zinc at its junction with the walls of the house are not carried high enough to prevent the water rising above them and causing injury. But this is by no means the case with the rolls which unite the plates. If these have not been artificially cemented—and we believe there are few cases in which they are so—the water will soon rise above them, and must find its way freely into the house. It therefore behoves all dwellers under the new flat roofs to exercise every precaution to clear away the snow upon them before a strong thaw sets in. Neglect of it may very probably have very disagreeable and serious results.

LITERATURE.

Our Sea Coast Defences. By Lieutenant E. GRIFFIN, United States Engineers.

AN undoubtedly able essay with this title has been brought out by the Military Service Institution, New York. The scope of it is, of course, large, and therefore certain points only can be noticed.

The paper begins by enumerating the various designs illustrating the great increase in power in modern artillery. The review is a good one. By the way, 1872 must be a misprint for 1876 for the appearance of the 100-ton gun. There is a good table of modern heavy ordnance—p. 5. The figures in many cases agree with those given on Colonel Maitland's table in his United Service Institution paper of June, 1884, but with many additions, and with Captain A. Noble's corrections of 51,900 foot-tons muzzle energy for the 100-ton gun, and 61,200 for the 110-ton gun. Lieutenant Griffin says that the superiority of steel projectiles is not so marked against hard armour as wrought iron. This we should have regarded as an error were it not that on p. 45 he quotes the statement that steel shot broke up chilled shields much better than chilled shot. We are therefore inclined to think that he means that steel projectiles lose the power of passing through hard armour intact, while, on the other hand, those of Whitworth or Krupp have passed entire through many inches of soft wrought iron armour. This no doubt is true.

After the disheartening reviews we have had lately of British and foreign fleets, it is pleasant to read the English ironclads set down as fifty-six, compared with thirty-eight for France.

To come to the real subject of the paper. It appears that in 1868 considerable work was done in rebuilding barbette earth coast forts of stronger character to meet the increase in power in guns. This went on till 1875, since which date "*not one penny*" has been appropriated for "the *construction* of sea-coast defences," the money voted being even insufficient to keep up repairs. The author then reviews the armaments and forts, dwelling on the inefficiency of barbette batteries, owing to the evil of exposing guns to the fire of machine guns, and even well directed shrapnel fire. Torpedo defence has been developed to a great extent, but as the writer observes, this, unsupported by land defence, is of little value, so he concludes that there is not a harbour on the coast that could not be captured by the armoured fleet of any important Power.

A hostile fleet lying in the upper bay of New York would have within range two and a-half billion dollars' worth of destructible property in New York, Brooklyn, and Jersey City. Two or three hundred millions would, the writer thinks, be gladly paid to obtain exemption from such a calamity as a bombardment. New York pays over six millions annually for fire insurance A single outlay of $17\frac{1}{2}$ millions would provide complete defence to her harbour. Other cities stand in somewhat the same position.

Lieutenant Griffin does not suggest that all harbours should be fortified, but only those where the importance of defence would be commensurate with the cost. Merchant ships and also those of the navy need harbours of refuge, and any place available as a base of operations for an enemy must be secured. This is the more important as no nation except England has any fortified station near, and any fleet could only be maintained by the continual use of coal transports. The writer then deals with three pleas commonly urged against the need of coast fortifications.—(1) That the navy alone should constitute the defence. (2) That torpedoes alone will suffice to close any channel. (3) That earthworks can be thrown up in the event of war. Against the proposition of depending wholly on the navy for defence, it is urged that this would condemn the navy to inactivity, and also that the States will never have a navy sufficiently strong for the purpose. (2) Torpedoes can never be self-depending and may be easily destroyed piecemeal if ships can do it at leisure and in security, which must be the case if they are not defended by batteries. Lastly, earthworks could never be made of the strength required in time of need, and the ordnance now required, with the necessary mountings and magazines, are constructions far too vast and complicated to be improvised.

Lieutenant Griffin then describes modern defences as consisting of three lines. (1) An outer line of war ships, (2) skirmish or torpedo boats, (3) land forts and obstructions, and fixed torpedoes or mines. With regard to torpedo boats we find the strength of England estimated as much greater, in comparison to that of other Powers, than we are in the habit of hearing it estimated in this country. In this, much depends on the date on which the estimate is made. England, we read, had in 1883, 129, France 76, Russia 125, and Italy 53 torpedo boats. The States have none. Batteries and submarine mines are regarded as specially important, and the cost of turrets is discussed. The strengthening of existing masonry forts by front plates is considered, and the position of coast batteries, especially with reference to the value of high command, and of rifled mortars, and also the effect of "quick fire" guns and machine guns. The Hotchkiss, Nordenfelt, Gatling, Gardner, and Maxim are noticed, as well as submarine mines—termed by the writer torpedoes. The features of the defence of New York Harbour; the question of armour and the action of projectiles on it, follow. The classification of armour, as hard or soft, and the behaviour of each under fire, is clear and definite. The results of experiments in England and on the Continent are followed by a summing up which appears to be able and worthy of notice, though we do not altogether agree with it. It is a little surprising that Grüson's armour does not find great favour in a country where iron casting is much advocated, the dome form being thought to necessitate large foundations. Steel is not preferred to compound armour at present, but evidently would be preferred if its price were to fall much.

THE PANAMA AND SUEZ CANALS.

NOT being able to procure the money which will be required for the completion of the Panama Canal from ordinary subscribers, M. de Lesseps needs the support of the Government of France. An issue of six hundred millions of francs in lottery bonds was decided upon, but through the action of M. Christophle, governor of the Crédit Foncier, and his suggestions concerning the national character of the work, and at the request of the company, the Government of France resolved on sending an engineer to Panama to examine the works, and see whether the enterprise could be completed. It made choice of M. Rousseau, one of the most distinguished French engineers, after whose report a decision would be arrived at. Many persons objected, and still object, to this step being taken by the Government. One of two things, they say, must happen. Either M. Rousseau's report will be adverse—in which case the enterprise will be literally annihilated, the responsibility of this collapse falling on the Government; or it will be favourable, in which case the Government, on the report of its official adviser, will sanction the loan, thus becoming seemingly responsible for the success of the affair, and being necessarily involved in international difficulties should any arise.

To these objections it has been replied, that if M. Rousseau's report were adverse, the consequences for the company might certainly be disastrous, and the capital embarked might be seriously jeopardised; but this would be rendering a service to French capitalist, if not by saving what was already embarked, at least by preventing any more from being sunk. As to the Government being involved in case of international difficulties, it was urged that whether M. Rousseau went out or not, the enterprise, owing to the presidency of M. de Lesseps, and to the capital being almost exclusively French, was virtually a French one, so that if international difficulties arose the Government could not in any case be unconcerned. As to the responsibility devolving on the Government towards capitalists making further investments on the faith of M. Rousseau's report, his ability and honesty were so undoubted that the Government could not hesitate to accept the responsibility of a report in favour of continuing the works.

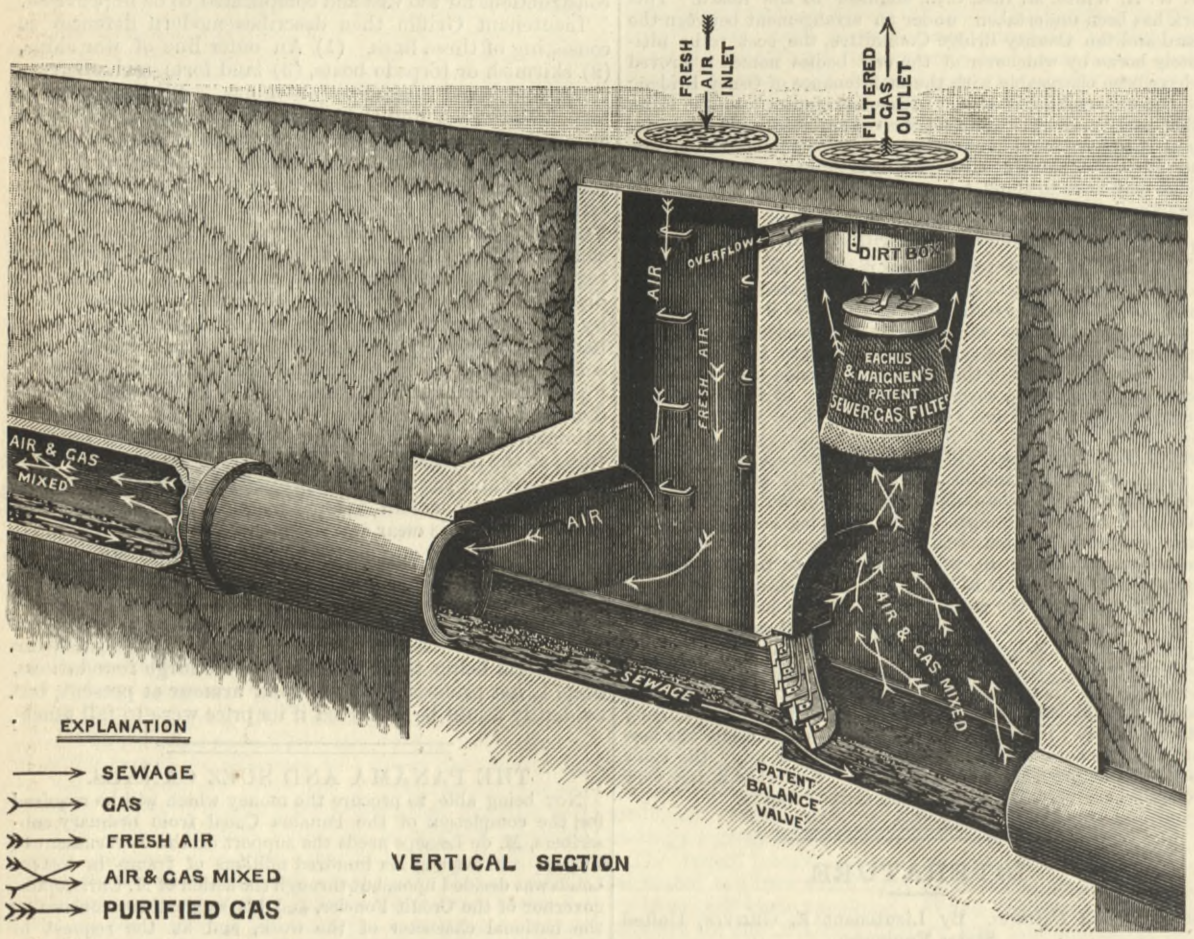
A well-informed writer in the *Times* says: "His mission, moreover, does not consist in deciding whether the enterprise will be lucrative or remunerative. He will not report on the financial prospects of the canal, but will simply state whether with fresh efforts the canal can be completed. This point settled, the capital embarked, like that in any other concern, must take its chances of success or failure, according as the traffic has been well or ill calculated; but on this point no engineer, and, indeed, nobody else, can speak with certainty. At the outset nobody supposed that the traffic of the Suez Canal would so rapidly assume its present proportions, and scarcely eight years ago the English Government bought at 500f. shares from the Khedive, which some years afterwards were quoted at 3000f. Thus, even years after the Canal was in working order, it was impossible fully to foresee the growth of the traffic. Much less is it possible to foresee the financial results of a canal not yet completed, and M. Rousseau will simply have to say whether by certain sacrifices the canal can be made available for shipping. This mission, however, is a very important one, for until he reports, the completion of the canal will be considered uncertain."

So not only is M. Rousseau going, but M. de Lesseps is going, and will embark at Southampton for Panama on the 28th inst. He has invited the Chambers of Commerce of Paris, Marseilles, Havre, Rouen, Bordeaux, and Lyons to appoint each a delegate to accompany him. England, Holland, Germany, and the United States will also send delegates. The company pays all expenses, expecting that all doubts as to the completion of the Canal, on which twenty-seven contractors are at work, all tied down to certain dates, will be removed.

The difficulty concerning the work of widening the Suez Canal, permission to proceed with which has been withheld by the Egyptian Government, does not seem to be quite so simple a matter as has been supposed, and the Egyptian Government has more reason to impose restrictions on the doings of M. de Lesseps' company than most folks have allowed, and if the Egyptian Government can see that its sanction is worth a good deal, there is no wonder, when it is remembered that a company that earns fabulous dividends and which proposes to make certain concessions to its shipping supporters, only after 18 per cent. dividend is reached, may expect to pay something for its right of way.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—John A'Court, chief engineer, to the Hyacinth; James Shirwell, engineer, to the Inflexible; and William H. Matthews, engineer, to the Caroline; Stephen H. Blundell, to the Victoria and Albert.

EACHUS' SEWER VENTILATOR.



EACHUS AND MAIGNEN'S SYSTEM OF TREATING SEWER GAS.

THE engraving shows an arrangement for the ventilation of sewers invented by Messrs. Eachus, of 3, Great Queen-street, Westminster, and Mr. P. Maignen. It has been practically tested at Edmonton, where it has proved the means of doing away with smells from ventilators on those portions of the sewers which are connected with some ancient drains in the district. As will be seen from the drawing, the system involves the division of manholes into two, or the construction of new double or divided manholes; and besides being applied to main sewers has been applied to house drainage in the case of the Town Hall at Edmonton. The middle wall shown on the plan may be replaced by a movable division constructed either in metal or wood, the lower part only of the wall being retained to receive the movable division. On this lower wall a valve is fixed, constructed in sections, each of which may be worked independently of those above, and the bottom section or sections may, if desired, be be left out altogether so as to give an absolutely free passage for the normal flow of sewage. The effect of this division wall or lattice and valve is to stop the back flow of sewer gas, to divide the sewer into short lengths, thus preventing any accumulation of gas, and to give a free run to the sewage.

The varying flow of sewage, in wet and dry weather, and by day and night, secures a constantly fresh supply of fresh air and the division of the sewer into lengths increases the circulation, causes any gas generated to be diluted to the greatest possible extent with atmospheric air, and keeps the temperature lower than under any other system.

Any kind of filter may be fixed in the gas outlets under this system, but the patentees have provided a form of filter which is very simple, and contains an ample supply of charcoal for a year's use, the charcoal being kept free from damp from above by means of an overflow, which discharges all surplus water from the dirt-box over the filter into the air inlet, where it runs away with the sewage. The damp from the sewer is condensed on the under side of the filter, which is in the form of a double cone of metal, perforated; and the charcoal taken out after several months' use has been found to be dry. One filter has been in use for twelve months. The lower edge of the filter is encircled by a ring of asbestos cloth to make an airtight joint, and this part of the filter does not require perforation.

The upcast shaft, which is shown in the form of an inverted cone, may be made in any other shape, provided that a ledge is formed upon which the filter can rest, and where a movable division is used, it is by preference made square for convenience of construction.

The advantage of the system is that there is a free run for sewage from the water-closet in the house to the final outfall of the main sewer. The patentees prefer the use of trapless valve closets and the balance or flap valve shown in the drawing, without any syphon traps, so that there is one continuous free run for the sewage, and a free circulation of air through a series of down and upcast shafts along the lines of the main, branch, and house sewers.

The manholes are usually constructed in concrete, and provision is made for the prevention of any up draught in the downcast shaft; but twelve months' experience has, we are told, shown that such provision is not necessary except under very abnormal conditions.

The system is about to be tried by Mr. W. G. Laws, C.E., in certain places at Newcastle, where the ventilation has given trouble. A medal was awarded to Mr. Eachus at the Inventions Exhibition for this invention.

WATER SUPPLY OF SMALL TOWNS.

WALTON-LE-DALE, LANCASHIRE.

AT the monthly meeting of the Walton-le-Dale Local Board, held on the 4th inst., a report upon the progress of the new works of water supply was presented by the engineer, Mr. William Wrennal, of Liverpool.

The Local Board constructed works of water supply to their district some four years ago. The pumping station is situated in the adjoining township of Brindle. A well 8ft. in diameter was sunk to a depth of 110ft., and a bore hole was continued from the bottom of it, down to a total depth of 537ft. from the surface. The yield from these two sources was, however, found to be considerably less than had been anticipated, and after some two or three years' pumping the supply proved to be quite inadequate for the then requirements of the district, and especially during the late dry seasons. Under these circumstances the Board, some twelve months ago, called in Mr. Wrennall to advise them in the matter, he having recently designed and carried out a complete scheme of works of water supply for a neighbouring authority—the water in this latter case being obtained in almost unlimited quantity by the sinking of a well and bore-hole in similar geological formation to that in which the Walton works are in. After making a careful examination and inquiry into the various considerations involved, Mr. Wrennal prepared and furnished to the Board a report and scheme upon the best means for increasing the supply at the Walton works. The surface at the well is at an elevation of 310ft. above Ordnance Datum; the geological features of the neighbourhood are very varied, the formation being chiefly the millstone grit series of thick beds of shale with alternative layers of rock. The chief recommendations contained in Mr. Wrennall's report were that headings should be driven from the bottom of the well to cut the various strata transversely, also trial borings sunk as might be found desirable. He estimated that by so doing the supply of water might be doubled at a comparatively moderate outlay. The matter was taken into consideration by the Board, and they decided to carry out the works recommended, and gave instructions for the same to be proceeded with. Estimates were obtained, and the contract was let to Mr. Thos. D. Lewin, contractor, of Manchester. The population of the district to be supplied by the Board is upwards of 9000, and there are also several large and important manufactories in the neighbourhood. The yield of water at the commencement of the present works was about 65,000 gallons per day, but it will be seen from the report presented last Monday to the Board, and given below, that this quantity has now been about trebled by the recent operations. A severe test has been applied to the yield by continuous pumping night and day during the progress of the works, and it is found that the increase obtained is of constant flow and does not appear to diminish.

At the commencement of the headings the cutting proceeded in beds of shale and rock for a length of about 150 yards, and in this length the strata was quite dry; a large upthrow fault was then met with some 30ft. in width, and water was found after passing through it. Cross headings were then cut in various directions, and up to the present a very satisfactory additional yield has, we are informed, been obtained. The headings at completion will form much needed underground reservoir space. "The branch heading, which was yielding water at the face, has been continued during the past month, and the work all through has proved to be very successful in procuring water. This heading has now been cut to a length of 105ft. from the main heading—the last 68ft. having been driven during the past month. The cutting is in the direction parallel to the large fault which crosses the main heading and follows close to it all the way. The rock roof of the cutting terminates at the fault and as the dip of the strata is towards the fault, the heading is in the favourable position to receive as it is continued, all the water which the rock contains. The strata has been mostly wet, and in places some large streams of water have been tapped, which have added very considerably to the total yield. The quantity pumped at the present time is about 190,000 gallons per day, as against 145,000 gallons per day reported last month. There is also every probability, from the knowledge now acquired of the favourable position of the present cutting, that further water may be procured as the heading is continued to be extended. The total length of headings cut up to the present time is 220 yards."

SOME of the papers are reporting that "The Royal Arsenal authorities at Woolwich have successfully adopted the American idea for moving buildings without taking them to pieces. A large wooden building, the waterproof store, 100ft. long and 30ft. wide, is thus being slowly transported to its new position in its entirety." We need not credit America with what is old at home. In 1848 a six or seven-roomed brick house at Ipswich was moved a considerable distance by William Worby, much as he would have moved a ship, the house being first raised by means of folding wedges.

LETTERS TO THE EDITOR.

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

AUTOMATIC COUPLINGS.

SIR,—Notwithstanding the many improvements which have been effected during the last few years in appliances for facilitating the working of traffic on railways, it seems that there is still much room for improvement in many ways, and although means may be at hand for effecting saving, not only in working expenses, but also in the saving of many of the useful and valuable lives which are annually lost, it requires much time and often much outside pressure to persuade railway directors to adopt the means to ensure the above-named ends. I refer more particularly to the lives of the railway servants, who are engaged in perilous work, and who are obliged from necessity to risk their lives in order to gain their daily bread, and whose lives are generally considered by railway companies to be quite a secondary consideration to the outlay of a few thousand pounds of capital.

From returns made by the Board of Trade, it appears that last year in this country alone 130 men were killed and 1305 were injured while engaged in shunting operations, and during the last seven years 1081 men have been killed and 9256 have been injured. This appalling loss of human life surely points to the necessity of adopting some means to protect the lives and limbs of a hard working and industrious class of men, for it may easily be seen without going into further figures what a great amount of misery must be caused by the loss of life and loss of limb, not only to the poor men who have to suffer the pain, but also to those wives and children who are in many cases rendered desolate and destitute through the loss of the bread winner.

My attention was especially attracted to this subject a few days ago by an invitation which I received to visit the East and West India Docks, where, by the courtesy of the officials, I was enabled, in company with several other gentlemen interested, to see the practical working of Mr. J. H. Betteley's patent automatic railway coupling.

This invention, the object of which is to couple and release railway vehicles of every description automatically without incurring the danger to the shunters of going in between the buffers, may be described as follows:—It consists of a long shackle which is attached to the draw-bar, and stands out at a slight angle of depression from the carriage or wagon. Connected with this shackle is a hook of special shape, which is attached to a bar running across the end of the vehicle, and having a short lever fixed on either end just outside the buffers. To couple the vehicles, they are run together in the usual way, and on meeting the shackle on one carriage runs up the shackle on the other, and instantly engages with the hook. Thus the shunter has no dangerous work whatever to perform. To uncouple, he has simply to depress the lever, which action raises the hook and releases the shackle. The hook is so formed that no matter how much bumping of the vehicles there may be, it cannot be freed from the shackle without the intervention of the lever, and the combination therefore forms a perfectly safe and reliable coupling—in fact, the whole train can be coupled up automatically, and the engaged hook and shackle then constitutes a locking apparatus which prevents the carriages becoming accidentally detached. The coupling can be used for any description of railway vehicles, and it is of no moment if the couplings are not on the same level, as is often the case when a heavily-laden truck requires to be coupled to an empty truck, as the higher shackle will always travel up the lower one and engage with the hook of the latter. The apparatus is strong and simple in construction, having neither springs, rollers, nor gearing to get out of order, and it can be fitted to the existing rolling stock at a cost probably not exceeding that of the present chain couplings. It allows free play for the buffers, and is equally efficient with spring or dead buffers. The hook and shackle have sufficient play laterally to obviate the risk of undue strain in traversing the sharpest curves, inclines, or cross-over roads, and the locking movement obviates the danger of couplings over-riding. Many benefits would doubtless accrue to railway companies by its adoption, and one of the chief facts which must not be lost sight of is that the patent coupling can be used in conjunction with the ordinary coupling, in which case the releasing motion is available. This adaptability at once does away with the objection that its partial adoption by railway companies would cause confusion in the making up of trains. There would also be a great saving in working expenses, for as it takes only half the time to couple up a train with the automatic coupling, as compared with the ordinary coupling, less men would have to be employed, and less time wasted in making up trains. It is estimated that it would create a saving of at least 50 per cent. in the shunting expenses. It may be of interest if I now describe the experiments which I witnessed at the East and West India Docks a few days ago.

The first trial was by first detaching the trucks and then pushing them violently together with a powerful coupled engine. The result was that the trucks coupled themselves together without hitch. The second trial was what is called a flying shunt—that is, unhooking the trucks whilst they are running. This is one of the most dangerous duties which a shunter has to perform, many men being killed outright whilst performing it; but with the automatic coupling all the shunter had to do was to lift up a lever when the truck passed, and each truck was so detached and sent on to its respective road. The third trial: The two trucks were taken on to a curve of two chains radius, a curve that the engine was not permitted to work upon; but although the spring buffers were a great distance apart on one side and close up on the other, the coupling answered splendidly in detaching and coupling. The fourth trial: This trial was for the different height of the trucks loaded and unloaded. Pieces of wood were inserted under the coupling to represent a truck loaded and unloaded, one coupling being many inches lower than the other; but on pushing them together the new coupling was found quite equal to this trial. I may add that the men engaged in the work were loud in their praises of the efficiency of the coupling, and my opinion is that this invention is equal in utility to the automatic brake, which has been the means of saving so many lives.

The Betteley couplings have been tested by the Board of Trade, and in consequence of the recommendation of their officers, General Hutchinson and Major Marindin, the Jury Commissioners of the International Inventions Exhibitions decided to award a special prize medal to the inventors.

ERNEST COLLINS, A.M.I.C.E.

New River Office, E C., January 4th.

ROTARY ENGINES.

SIR,—"R.," in his lucid review of "Inclined Shaft Rotary Engines," in your issue of the 18th inst., does me the honour to refer to my rotary device, in connection with its possible embodiment in the form of a steam engine. This application of the device is in contemplation; but it has not yet been carried out, and misconception of its character, in the meantime, may be a hindrance to its development. I would, therefore, beg you to do me the favour to record the following remarks in correction of what appear to me to be oversights on the part of "R." He says that the pistons—referred to also as "knuckle pieces"—"do not merely pass in and out of the cylinders but turn in them at the same time. With this double movement set up, it would seem that greater wear must be looked for." The knuckle pieces—which I call "coupling pieces"—need not necessarily form the piston-rods. Piston-rods without themselves turning may be arranged to drive coupling pieces which do turn on their own axes. But even the coupling pieces need not turn in their guide holes if provision be made for freedom to rotate at the knuckle, as, in fact, is arranged by the ordinary crank pin connection for piston-rods. One element of my coupling pieces may be regarded as simply an accommodating crank pin, and the other element as a connecting-rod moving parallel to itself. Consequently, it would appear to me to be erroneous to anticipate that greater wear should be looked for in the piston action associated with my device. It is also suggested that in turning the device into a rotary engine "it might be necessary to gear up the shafts by bevelled cogs, so as to relieve the working pieces upon which the steam would act from too much strain." The pieces here referred to are, I presume, the coupling pieces. Bevel gearing is, I think, quite unnecessary, for the following reasons:—

The relative positions of the coupling pieces are exactly determined by the relative positions of their guide holes. The guide holes are in two sets, one for each set of ends of the coupling pieces. It is, of course, impossible that the relative positions of the guide holes composing either set can be deranged. But when two sets of guide holes are coupled up no alteration of the one set relatively to the other can take place without affecting all the coupling pieces. Disturbing strain cannot confine itself to one or more of the coupling pieces; it must necessarily affect all at the same time. Bending or yielding of any coupling piece implies loss of correct relative position of the piece's guide holes; but loss of correct relative position between these holes implies corresponding loss of adjustment of all the other pairs of guide holes, to which action there would, of course, be offered simultaneous resistance by all the other coupling pieces. The coupling pieces may be made of such a size that their combined power of resistance shall be greater than would be offered by a cog of a bevel wheel. Should additional support be necessary, it may be largely and conveniently given by providing a central bent axle conforming to the coupling pieces. It will assist in realising the manner in which the coupling pieces afford mutual support to one another, to consider the case of using them straight—as a link in a continuous line.

If the length of the gap thus bridged in a straight line of shafting be made equal to the distance at which—in right angled coupling—the line of axis of one shaft is from the face of its companion shaft, the mechanical efficiency of the two sets of coupling pieces will be alike. The shafting and coupling pieces being of equal strength in the two cases, the resisting power of the couplings to strain and torsion will be equal. In comparing the characteristics of the various rotary engines, "R." has not noted that in the Tower, Fielding, and Dawes engines, the steam does not act at any instant in the direction of the required motion of rotation. In my device, the steam pressure effective in producing rotation acts—during each revolution—six times as a mechanical couple directly in the line of rotation, *i.e.*, tangentially to the circle of revolution desired to be produced. In my device, say with six cylinders—and ten or perhaps twelve are practicable—the steam pressure effective in producing rotation varies between a maximum and mean little separated, and the engine has no absolute dead points. "R." has invited comparison between my device and the Dawes "Omnivolvent" engine by classing them together. The connecting-rods of the Dawes engine not only act disadvantageously in direction at all points of revolution, but fight amongst themselves; for, with the exception of two at the instant of half stroke, they are at constantly varying angles of inclination with one another. Dispense with the bevel gear of this engine, and it will at once be seen that the shaft may be turned through a considerable arc without the engine turning at all; and were steam applied under such circumstances the result would, I imagine, be disastrous. The bevel gearing of the Dawes engine is then an essential element; but with my device such gearing would be superfluous.

As regards bulk of my device, the cylinders of a six-piston engine—4in. diameter and about 5in. stroke—can be effectively arranged within the limits of a drum of about 12in. in diameter and 24in. in length; and the arrangement would permit of steam being supplied to only three, or to all six of the cylinders at discretion. Thus arranged it could be employed to turn a single shaft or a pair of parallel shafts simultaneously with opposite directions of rotations, as with twin screws.

In making the foregoing remarks I have not been influenced by desire to detract in the least from the high merits of the Tower and Fielding engines. To me they are masterpieces of ingenuity, and are plainly applicable to many uses for which my device cannot pretend to be serviceable. Practically applied as those engines have been with success, it was only natural that "R." should have fully recognised their merits, and that in noticing my undeveloped device in the same article, he should have overlooked points in which it may prove to be not inferior.

D. R. CAMERON, Lieut.-Col. R.A.

Royal Artillery Barracks, Sheerness,
December 21st.

SIR,—The able article on "Inclined Shaft Rotary Engines" appearing in THE ENGINEER of this week is most interesting, and I hope, now the subject has been broached, to see it thoroughly ventilated by your readers who invent and who design. It may appear presumption to suggest that economical and durable rotary engines are not likely to be machines of the immediate future; for the best of the present day cannot claim in justice to be more economical, or more durable, than a well-constructed direct-acting reciprocating engine, which will run as silently, and at a speed to meet the present requirements. Examine what form of rotary engine you will, there are great mechanical difficulties to be overcome, and although those difficulties may vary considerably, yet in many there is a destructive power at work which must ultimately show itself, and that is centrifugal force. Many designers and inventors must have overlooked or declined to cope with it.

The engines represented by Figs. 3, 5, and 6 of your last journal must be considerably affected by this unavoidable and natural power. Another point which appears weak in the inclined shaft rotaries is the fact of the line of force not being directed to give off the maximum amount of useful work to the best advantage. Figs. 2, 3, 5, and 6 of the same issue illustrate engines that impart a large proportion of the force of the steam against the port faces, which act as thrust blocks. This force must necessarily be largely absorbed by friction. It is needless to comment upon the absolute necessity of a constant and abundant supply of lubricant to these faces or thrust blocks.

What are the advantages of so-called "rotary" engines, having reciprocating parts, over a properly constructed reciprocating engine, having trunk pistons, which give a far more direct rotary motion to a crank-shaft? Is a rotary engine so named because it has no crank or cranks? for some reciprocating engines having cranks may be called "rotary" with equal reason. If length, breadth, and height alone are the points of advantage, I shall be content to remain

LONG CONNECTING ROD.

December 22nd.

THE PECULIARITIES OF STEEL.

SIR,—You are doing good service to engineers by opening your columns to the discussion of this question, and I venture to say if you will allow it to go on, and if those who know something about it will tell what they know, the mystery which at first surrounded the matter will be dispelled. There are at present before the public two separate tales of the failures of steel plates. The first is that told by Mr. Maginnis in your issue of December 11th, and which has been under discussion ever since. The second is that told by yourself in THE ENGINEER of 1st inst.

Now, let us take them one at a time, and, to begin with, Mr. Maginnis' story ran thus. Some steel plates made by the Bessemer process—not the basic, as erroneously intimated by you—made by a good firm, and thoroughly tested under the inspection of Lloyd's and the Board of Trade, were by another good firm built into marine boilers; and after these boilers had worked satisfactorily for two and a-half years, the plates are found to have gone to the bad all at once. They have suddenly become so bad that, on the whole, it would be safer to go to sea in a torpedo than in a ship fitted with such boilers. This is the tale as originally written, and a very shocking one it is; but since Mr. Maginnis told it, one after another of your correspondents have come forward and have given us bit by bit other items of information, which materially modify the story. It now runs thus. Steel plates were made by a good firm, but by means of machinery which was much too light for the purpose, and which they have since discarded. These plates were made into marine boilers by another good firm, but only after testing them and rejecting over 40 per cent. of them as bad.

Now, Sir, Mr. Du Pre, speaking for the makers of the plates, can perhaps tell us if the plates were tested by them, if they have a record of these tests, and if so, how many tests, chemical and mechanical, were made, and the results of these tests; and will the boilermaker tell us the nature of the tests he applied, and which resulted in over 40 per cent. being rejected? and perhaps he will also tell us if, after finding 40 per cent. of the whole batch unfit for use, he had good grounds for believing that the remaining 60 per cent. were such as he could rely upon.

Now, let me call the attention of your readers to the fact that these plates were undoubtedly Bessemer, and not basic, and I will pass on to the second tale, and this time it is of basic steel, and runs thus. Some steel plates made by Bolckow, Vaughan, and Co. for shipbuilding purposes had passed Lloyd's inspectors, and in some cases had been built into ships, when suddenly they were discovered to be cracked in all directions, and Messrs. Bolckow, Vaughan, and Co. have declared they will make no more plates by the basic process; and Lloyd's, scared by this extraordinary breakage, and by the statement of Bolckow, Vaughan, and Co., have sent to their inspectors peremptory orders not to accept any more steel made by the basic process for the hulls of ships. Now, Sir, this is the story as told by you in last week's issue. There has been no time yet for modifications of it, but I have little doubt that in time other information will come to hand which will make it wear a very different aspect, and in order to draw out this information may I ask the following questions?—(1) Is it a fact that while Lloyd's have for the present stopped the use of basic steel in ships, they are quite willing to take it as before for marine boilers? (2) As Messrs. Bolckow, Vaughan, and Co. make steel by the basic, the Bessemer, and the Siemens processes, will they say if these bad plates were all made by the basic process—which they say is so unfit for the purpose? also, if it is true that many of the rejected broken plates are marked S, and if so, if this letter S has anything to do with the process of manufacture? (3) Is it true, as stated in THE ENGINEER of last week, that these bad plates have been found to contain a large excess of phosphorus, some even as much as ¼ per cent., and if so, if this excess is not quite sufficient to account for the breakages? (4) Do not Bolckow, Vaughan, and Co., in common with all other steel rail makers, and by any of the processes, turn out constantly and with the greatest certainty and regularity steel which contains less than one-fourth of that quantity of phosphorus? (5) Is it not a fact that no known process of steel-making can with such ease and certainty eliminate phosphorus as the basic process?

Bad materials, both in iron and steel, have been and will be turned out occasionally, even by the best makers, and by every process, but these bad materials will never find their way into finished structures if a reasonable use is made of the testing machine and the laboratory; and my opinion is that neither of the cases under review have proved anything whatever against any process of steel-making. Steel for either boiler or shipbuilding is undoubtedly superior to iron, but it needs more care in making and working up, and if we can get more light on these two cases, it will show nothing more or less than gross carelessness somewhere. In the meantime, it is absurd for Lloyd's to stop at a moment's notice the permission they gave long ago, and which they only gave after years of careful experimenting and consideration. If any particular firm has made bad steel, as seems to be case, let them try and find out the reason why, and obviate it in future; but other makers are making steel by that process with a regularity of quality which leaves little to be desired. I do not believe in plates being good to begin with, and turning suddenly as brittle as glass after two and a-half years. I think it will be found the steel was bad to begin with, and moreover, that its badness might easily have been discovered before it left the rolling mills.

January 8th. L.

DR. LODGE'S MECHANICS.

SIR,—I cannot agree with "Φ. Π." in considering that the discussion raised by his first letter on this subject has reached a legitimate conclusion. To one only of my questions has he given an explicit reply, and in that reply he stated that he was wrong, where in my opinion he was perfectly right. It will require *double* the force to produce the same velocity in a body whose mass is double that of another, the two forces acting during the same interval of time. I know nothing of the system of polars to which "Φ. Π." refers, and cannot therefore appreciate his explanation. The matter under discussion can be thoroughly sifted without any reference to that system.

If either the definition of motion given by Dr. Lodge, or that given by myself is correct, the definition of momentum as Quantity of Motion is simply absurd. In accordance with either definition, motion can only be measured by a linear interval. If $v\,m$ W be the velocity, mass, and weight respectively of a body in motion, the three quantities are connected by the equation $m\,v = \frac{W\,v}{g}$. Since $\frac{v}{g}$ is a simple ratio if the equation of relation is correct, momentum can be represented by a moving force equal to the weight $W\frac{v}{g}$. How can the same thing represent a weight and a quantity of motion. Either "Φ. Π's." definition of momentum, viz., quantity of motion, is wrong, or the equation of relation is wrong. The equation is, however, perfectly right, and will be found to be in accord with the following definition of momentum:—

The momentum of a body of given mass moving with a given velocity is equivalent to a moving force, which acting upon the given mass can produce the given velocity in an unit of time. Does "Φ. Π." still maintain that the acceleration produced in different bodies by a given force acting during a given time vary as the masses of those bodies?

In adopting capacity for motion as the definition of momentum, "Φ. Π." seems to have been guided by the following course of reasoning. *Ex nihilo nihil fit*; if there is no body to move there can be no motion. Everything can be moved, therefore everything possesses capacity for motion. Everything also possesses inertia, therefore, he would say, inertia is capacity for motion.

WILLIAM DONALDSON.

2, Westminster-chambers, January 11th.

FREE TRADE AND NO TRADE.

SIR,—I know that the correspondence columns of THE ENGINEER are always open for the discussion of questions which possess interest for engineers, and I venture to hope that you will permit the consideration in them of one of the most important questions that your readers can discuss. It is quite possible that the opinions I hold and the sentiments which I desire to express may not be consonant with your own views; but I do not suppose that for this reason you will close your columns against me. I propose to consider whether a Free Trade policy is, or is not, the best policy for England. In this there may be nothing novel; but I propose, further, to try and discuss it without any of that heat and passion but too often manifested by those who approach the subject. Before going further, I may say that I am neither a Protectionist, a Free Trader, nor a Fair-Trader, and I hope to show that it is a great mistake to advocate as exclusively and absolutely right under all conditions, the views of either Protectionists, Free Traders, or Fair-Traders.

One of the special cants of the day is that the attainment of abstract truth is the highest aim that an intellectual nation can set before it. Let everything perish—happiness, prosperity, life itself, if only truth can be reached. Now I am one with those who hold that there is no such thing as abstract truth. One of your correspondents pointed out not long since that there is no such thing in nature as an isolated phenomenon. I hold, in the same way, that there cannot be an isolated truth. For example, it is quite true that 2 + 2 = 4; but the statement would have no force or cogency unless we realised what unity and twice unity and four times unity mean. We have in this simple proposition not one, but four truths. When I say that 123479635721 + 123479635721 = 246959271442, not one man who reads this letter out of a thousand will accept the statement as true, so far as any initial internal evidence operates. He may take it as true because I say it is, or he may take it as true after doing a sum in simple addition, but for no other reason.

Now, so far as I know anything of the arguments of Free-Traders, they hold certain views which they maintain must be held by every-one who loves the truth. Some of these veiws belong to the 2 + 2 = 4 category. They are put forward as axioms. Others are to be taken like my statement that 123479635721 + 123479635721 = 246959271442. That is to say, the leaders of the Free-Trade faith tell their disciples that certain things are true, and the disciples must therefore believe them. Such a system of teaching is, I maintain, wholly erroneous. There is no such thing as abstract truth. There is no reason whatever to conclude that Free-Trade, or Fair-Trade, or Protection, is morally, or politically, or systematically right, in the sense that it invariably means the greatest good for the greatest number. Too much importance cannot be attached to this thesis. The neglect of it may lead to law givers, nay, to whole nations, committing the gravest mistakes. We must not assume because any commercial policy is said to be the best by the believers in abstract truth that it is really the best. In plain words, we are guilty of a grave error when we neglect the conditions under which a special policy has to be worked; and the condition of trade prevailing at any given time may, for any particular country, render either Free Trade or Fair-Trade or Protection the best policy for that country. I need hardly stop to point out that the thorough-going Free-Trader—such a man, for example, as Mr. John Bright—takes no account whatever of limiting conditions. To him it is an abstract truth that Free Trade is the best policy, and, therefore, it must be adopted or pursued.

It would be quite impossible within the limits of a letter of any reasonable length to discuss all the points that may be discussed in this connection. With your permission, I may return to the subject. My principal object in writing now is to induce such of your readers as have hitherto held that any one policy must be the best, to look at the question from my point of view, which is broader than theirs. I do not think that any, save a few, of your readers at least, will maintain that under no possible conditions can Free Trade, or Fair-Trade, or Protection be right. Rather they will, I hope, agree with me that any nation may find itself in such a position that any one of the three policies I have named may be adopted and pursued with more advantage than any other. To make my meaning perfectly clear, I shall say that I hold that the repeal of the corn laws was the best policy that Great Britain could possibly have adopted *at the time.* England was even then a great manufacturing nation, she was in a position to supply the whole world with manufactured goods which the other nations could not produce. The one thing essential to Great Britain was cheap food, to maintain a population not engaged in the production of food. It was also urged that those who grew corn should have the greatest facilities for selling it, in order that they might have money to buy our manufactures. Yet even at the time the throwing open of our ports for the introduction of foreign corn meant comparatively very little; the supply of grain to be had from America was very limited; the cost of carriage was very great, and the carriage itself was very slow. In 1848 Indian corn—maize—meal sold in Ireland for £27 a ton after the Corn Laws had been repealed. Famine desolated the land as much because of the absolute impossibility of getting food into it at any price as from any other reason. Is it not easy to see that the conditions are now totally different? I am not about to say that a tax should be put on imported grain now; but I do say that if the Corn Laws had now to be repealed, no statesman could employ the arguments used in 1848 with great force and truth. Be it remembered that in this matter of taxing corn I am not advocating any policy; I am only urging the fact that the circumstances of the country in 1847 were so widely different from the circumstances of the country in 1886, that what might have been a wise policy in 1847 is not of necessity a wise policy now. If this be true of a given country at given periods in its history, I say that it may also be true of any country, and that before we can say which is the best commercial policy for a country to adopt we must take into consideration all the conditions regulating and controlling its commercial operations.

Unfortunately there is in existence in this country a number of individuals of more or less influence who refuse altogether to admit that Free Trade can ever be wrong, or that the Protection of industries can ever be right. In a word, they hold it as an abstract truth that Free Trade must be right. The Government appointed a Commission to investigate the causes of the existing depression of trade, and these lovers of abstract truth did their best to stifle the inquiry. To dispassionate outsiders like myself this seems an evidence of weakness; but this is, perhaps, a digression.

I now come to consider another phase of the subject, and I begin with the proposition that that policy will generally be best which does the most good to the greatest number. Even this must be taken *cum grano*, because there are contributing conditions which may indicate that a departure from this policy may for a time be advisable. Broadly speaking, however, the proposition is generally true. Now it is for the advocates of Free Trade and the advocates of Protection to show that for England at the present time either policy will do more good than the other.

I have said that I am neither a Protectionist nor a Free Trader, by which I mean—as will, I hope, have been gathered from what I have written—that I am not a thick-and-thin advocate of either policy as abstractly the best, and therefore that to be adopted under all circumstances; but I do believe that the conditions under which Great Britain now finds herself are those which indicate that the adoption of a moderate policy of Protection would be best for her, and I hope to give satisfactory reasons for making this statement and holding this faith.

The primary argument of the Free-Trader is that the consumer should have what he consumes at the lowest possible price. Around this central axis rotate, so to speak, all other propositions and arguments in favour of Free Trade. It is very singular that those in favour of a Protectionist policy elude or slip round or avoid this proposition. They seem to fear it, yet it is only necessary to grasp it firmly to find it vanish like a soap bubble. Let us carry the proposition to its legitimate end, and assume that corn, and meat, and cotton goods, and iron, could all be produced abroad and put into this country at one-tenth of the present price. Let us suppose that meat costs 1d. a pound, calico ½d. a yard, iron 2s. a ton. The immediate result would be the total ruin of the farm labourer, the cotton spinner, the ironworker, and the landlord. Let me confine myself to one class. Cotton cloth imported at ½d. a yard would mean the shutting of all the mills in Lancashire, and all the engineer's shops supplying machinery for spinning cotton. It would be a matter of no importance at all to the Manchester cotton mill hand that meat was a penny per pound, seeing that he would not have a penny to buy it with. The only persons who would benefit would be the capitalists—that is to say, the men possessing gold, *or drawing an income, paid in gold, from foreign countries;* and even these men would not long enjoy their wealth, because a starving nation would arise and deprive them of it. There is no possible way that I can see of refuting this illustration, and I assert that the lowest price to the consumer does not represent of necessity the greatest good. To say that it does is another of the wretched abstract truths which entirely disregard limiting conditions.

I shall now only trespass on your space with one more proposition. It is always maintained by the Free-Trader that when a tariff is imposed the consumer has to pay it. I maintain that this is not universally true. It is not true except under certain special conditions. I shall have no trouble in getting your readers to endorse my view of the matter; for they know very well that *they* have to pay the larger share of hostile tariffs if they desire to force sales. Is it not because of hostile tariffs that portable engines and tools, to say nothing of manufactured goods of various kinds, have fallen in price year after year? Would steel rails be £4 2s. 6d. a ton now, if it were not for Protection in the United States? A great deal has been said concerning the repeal of the Corn Laws giving us cheap corn. We hear the cheap loaf constantly spoken of as the result of the repeal of the Corn Laws. It may startle many of your readers to learn that corn has been dearer since that repeal than it was before; and that it has been as cheap before as it has been since. It was believed—it is believed now—that the repeal of the Corn Laws induced a much larger importation of corn than would have been had without it. This proposition has never been proved. The idea is that more bread was consumed, because the duty was taken off. I do not believe this for a moment. Bread is a necessary of life, and the great bulk of the community have always, and under all circumstances, had plenty of bread. That was certain to be bought. If the price went up less bread was not consumed, but less meat, or tea, or sugar, or beer. If bread was excessively cheap more of it might be wasted than is wasted now, but this is beside the mark. The quantity of bread per head of the population used now and in 1820, or any subsequent period, has remained unaltered. The demand for it will vary with the population, and with nothing else, and the repeal of the Corn Laws did not cause more bread to be used, nor did it cheapen the cost of wheat, as the following figures show:—In 1820 the price of wheat was £3 7s. 11d. per quarter. In 1835 it was £1 19s. 4d. In 1846 it was £2 14s. 8d. The following, or famine year, it rose to £3 9s. 9d. In 1848, after the repeal of the Corn Laws, it fell to £2 10s. 6d.; in 1851 it fell to £1 18s. 7d.; but in 1854 it rose again to £3 12s. 7d., and in the following year to £3 14s. 9d. It is, indeed, very difficult to prove from prices that the repeal of the Corn Laws had any influence whatever on the value of wheat, which has been far more affected by the advent of the cargo steamer than by anything else. In other words, the grower of the corn abroad and not the consumer here paid the duty. Under no circumstances does the consumer ever pay the duty when the supply of any article virtually exceeds the demand. Now, and for some time past, the supply of corn has exceeded the demand, and the only effect that could be produced for some time in this country by the imposition of a 5s. duty on corn would be that the farmers in Russia and America would be worse off than they are now, if possible. When the demand exceeds the supply the consumer pays the tariff. When supply and demand balance each other, then the tariff is divided between the two. The foreign exporter pays one portion x, the consumer pays another portion y, and a certain portion of $y = n$ is returned to the consumer in the shape of diminished income-tax or its equivalent.

Here I must stop. I hope on another occasion to show that Protection may be made to play an important part, hitherto quite overlooked, as a distributor of internal wealth. TRADER.

London, January 9th.

REACTION WHEELS.

SIR,—Mr. Donaldson's statement that the efficiency of reaction wheels cannot exceed about 30 per cent. is flatly opposed to that of Weisbach, who gives it at 66 per cent., and this view is adopted by Rankine, since he says, "The greatest efficiency is about two-thirds." See "The Steam Engine and Other Pressure Motors," page 200.

It appears to me that Mr. Donaldson has quite failed to understand the use of the curved arm, which is to prevent the water from acquiring any angular velocity in the direction in which the wheel is rotating. Let us suppose that a straight arm is rotating with a circumferential velocity of 20ft. per second. Then every pound of water which escapes through the orifice must first have a velocity of 20ft. per second imparted to it as it is carried round with the wheel, and the work done on each pound will be $\frac{1 \times 400}{64} = 6·25$. This is equivalent in other words to a loss of 6·25ft. of head. If the arm be curved then the water will move out in a straight line from the centre, and there will be no loss of head, because the water will acquire no angular velocity. There will be some loss due to increased friction, but not much. By suppressing arms altogether and substituting for them a large circular drum even this objection may be eliminated.

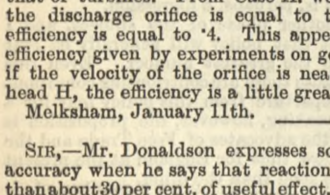
It is evident that if Mr. Donaldson be right the blades of centrifugal pumps, Guibal fans, &c., ought to be straight, and that their efficiency is much lower than careful experiment has already proved it to be. PYNX GRYPH.

Aberdare, January 9th.

SIR,—Mr. Donaldson, in his article on reaction wheels, remarks that the principle of action in those wheels is totally different from that of the turbine. We can hardly endorse this statement, since the formulæ for reaction wheels may be easily deduced from that of turbines. From Case II. we gather that if the velocity of the discharge orifice is equal to that due to the head H the efficiency is equal to ·4. This appears to be much less than the efficiency given by experiments on good reaction wheels, in which, if the velocity of the orifice is nearly equal to that due to the head H, the efficiency is a little greater than ·6. W. H. T.

Melksham, January 11th.

SIR,—Mr. Donaldson expresses some doubt concerning his own accuracy when he says that reaction wheels cannot give out more than about 30 per cent. of useful effect. The statement is flatly contradicted by many careful experiments. My object in writing now is to point out that he seems to have forgotten that curved arms in reaction wheels are better than straight, because they give less angular momentum to the water, and, when properly constructed, are driven directly by the outflow of the water.



Let A B C be one curved arm. The water will flow in a straight line from the centre to C, there it will be deflected, and in deflection it will powerfully tend to drive the arm in the direction of the arrow D. What is true of one stream of water as shown by the arrow is true of the whole body of water.

Whitelaw and Stirrett's wheel was a great improvement on Barkers mill. Will Mr. Donaldson say why, if not because the arms were curved? J. W. NORMAN.

Eccles, January 12th.

A PROBLEM IN INDICATOR DIAGRAMS.

SIR,—If I am not too late, I should like to give my opinion as to the indicator diagrams given in your issue of the 25th ult. In my opinion, they are taken from a compound condensing engine, and the peculiar shape of the low-pressure diagram is due to one or both of two causes, viz., as there is a vacuum in the high-pressure cylinder on the return or exhaust side, and a pressure fairly constant in the low-pressure, a supply of steam must be making its way into the low-pressure cylinder, and without passing by the low-pressure slide valve—probably, if the cylinder is jacketted, from that jacket; and this seems all the more likely, seeing that as the piston gets to the end of the stroke, and so ceases to enlarge the space into which the steam is flowing, the pressure increases and causes the diagram to show a curve. The reason why the exhaust line lowers gradually, instead of falling at once to a proper vacuum, I should say must be due either to this leak giving so much more steam to clear from the low-pressure cylinder that the eduction or exhaust pipes are not large enough, or that the exhaust is cramped in some other way, such as, for instance, in a surface condenser, all between the condenser tubes being blocked up with grease or fur. I may add that my reason for suggesting the last is that some months since, from a compound condensing—surface—engine, I took off from the low-pressure engine diagrams something like the one you give, but even more distorted, and the cause was traced to the reason I give, although the vacuum gauge still showed a good vacuum, there being a small pipe-like opening in the fur, &c., connecting the gauge and air pump. As to the valves or excentrics being wrong, holding the opinion I do about the ause, I could not give an opinion, as the diagram is so distorted that it gives no correct showing about them. The only thing I see about it is that there appears to be no cushioning in the low-pressure, and therefore probably the exhaust does not close soon enough. The high-pressure seems a fairly good diagram, and the valves properly set, but I should imagine that the piston or valve is hardly tight, the line being wavy or unsteady. In conclusion, I should imagine the engine to be a very economical one when the low-pressure is put right, the steam being expanded so much.

Wallsend-on-Tyne, January 9th. W. F. G.

SIR,—In reference to the indicator card problem, in your issue of December 25th, it seems to me that (1) the valves of both engines may be all right as far as setting goes. (2) There is something far wrong with the low-pressure cylinder valve face, probably a part of one of the bridges carried away, bringing one of the steam ports in connection with the exhaust passage. The engines are running with very little load; the high-pressure card seems to be taken off a Corliss, cutting off at a high grade, and the low-pressure a common slide valve, with expansion valve, which has been thrown out, the main slide valve having a very late cut off. (3) The engine is a condensing engine. I take it that the drooping line on the low-pressure card is the steam line, and on the piston coming to or near the end of the stroke, the slide valve opening to admit steam for the return stroke, steam rushes through the broken bridge on the cylinder face, and instantly destroys the vacuum, forming the vertical line on the card. The low-pressure engine now acts as a drag—the piston being in equilibrio—and is drawn round by the high-pressure engine, and near the end of stroke a slight compression takes place, forming the loop. (4) It may be that the low-pressure excentric, or equivalent gear, being misplaced on the shaft, causes the distortion; in that case the card would read opposite from above.

Custom House, London, E., January 10th. J. W. S.

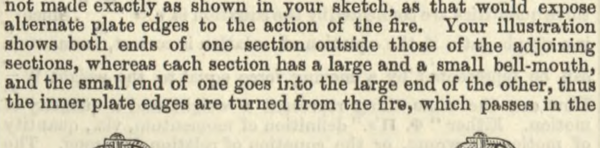
ENGINEERING CASES IN THE LAW COURTS.

SIR,—As I first introduced in your columns the question as to engineering trials in the Law Courts, and the inordinate length to which they are allowed to drag themselves out, to the very great cost and sometimes ruin of the litigants, will you allow me to supplement briefly my previous remarks? Mr. Spence, in your last issue, speaks only of patent cases, but there are many other engineering cases tried of equal importance to these, such as those arising from non-fulfilment of contract, quality of workmanship, materials, &c. In these I take it the appointment of an engineering assessor to sit with the judge is of more importance than in most patent cases, as a lawyer should be better able to understand the wording of a patent specification than to judge as to the quality of a bar of iron for instance. Or take a case in point. I am at the moment retained as a witness in a case as to the improper construction of machinery designed for a special purpose. This will necessitate the production in court of several more or less intricate models, the action of which it would be almost impossible for any but a technical man to properly understand. What would be the result of this? Under ordinary circumstances the case would probably drag on for many days, and end possibly without justice being done. We are all well aware that, so long as there is any money about, law cases are attended with delays, and we must not look to lawyers for redress. In the case I have mentioned I have advised my client to petition the Court for the appointment of an engineering assessor, and if this is granted I venture to say that the trial will be concluded in half the time it otherwise would, to the great gain, at any rate, of the litigants. Many engineering cases are referred to a public arbitrator, and as he is a non-technical man, the remedy is often worse than the disease. I have one case in my mind particularly, which lasted a fortnight and should have been finished in two days. Several men brought up as engineers are now at the Bar, and lay themselves out for technical cases. If it were possible to have barristers as specialists for different kinds of cases, we should be saved the laughable though costly exhibitions now often seen in the Courts. I am decidedly of the opinion that if some good men were appointed to act as assessors as occasion may require, it would be a very decided benefit to the engineering community, and I trust THE ENGINEER will further ventilate the question.

Appold-street, E.C., January 9th. M. POWIS BALE.

PAXMAN'S BOILER FLUE.

SIR,—We observe in your notice of our Paxman boiler flues in THE ENGINEER, 11th December, 1885, a slight error. The flue is not made exactly as shown in your sketch, as that would expose alternate plate edges to the action of the fire. Your illustration shows both ends of one section outside those of the adjoining sections, whereas each section has a large and a small bell-mouth, and the small end of one goes into the large end of the other, thus the inner plate edges are turned from the fire, which passes in the



direction of arrows, as shown in the accompanying sketch. This flue has all the additional strength of ringed flues combined with such elasticity as allows expansion and contraction to operate without straining the joints. Another advantage is the rivet heads are out of the line of the gases, or in other words, not subject to the scouring action of the flame impinging on them.

Colchester, January 12th. DAVEY, PAXMAN, AND CO.

TALL CHIMNEYS.

SIR,—You have been misinformed about the height of the highest chimney. Mr. Townsend's chimney at Port Dundas, Glasgow, is 488ft. from the foundation to the highest point of the lightning conductor, or 468ft. from foundation to cope stone.

Glasgow, January 13th. X. Y. Z.

ZINC IN MARINE BOILERS.

SIR,—As Mr. Phillips appears to be personally interested in protecting marine boilers from corrosion by the use of zinc or some other electro metal, I have no desire to continue this correspondence. I wish him success. Only in future it will be prudent on his part to refrain from criticising the motives of others, whose only object has been to advance the cause he himself is interested in. Originality in invention is an exceedingly questionable matter. Men invent and give to the world useful appliances and modes of manufacture without consciously borrowing ideas from their neighbours; but in the end it too frequently happens that the ground they have covered has been trod on before. In my own case, I worked hard for more than twelve months with an invention, deeming myself perfectly original, only in the end to find that similar ideas had occurred to a brother engineer. At the same time, I have seen two patents recently taken out which embodied designs I have had by me for several years. One related to an automatic method of feeding boilers, the other to an improved form of ship's rudder. But I am not foolish enough to suppose that the patentees of those inventions are indebted to me in any way; I recognise the possibility of other minds starting from the same known wants arriving at the same, or nearly the same, means of supplying those wants. JOHN A. ROWE.

11, Spring-terrace, North Shields, Jan. 12th.

FORCED DRAUGHT.

SIR,—In your review of the engineering progress of the past year in your issue of 1st inst., reference is made to my system of forced combustion in terms which are not only incorrect, but which, I believe, cannot fail to be also injurious. You say: "The excellent results obtained by Mr. Howden with one of Mr. Scrutton's ships do not appear to have been repeated in the case of further experiments with other vessels. Be this as it may, it is certain that no more vessels are being fitted on the Howden system at present." The inference evidently intended in the first sentence is that further, what you are pleased to call "experiments," have been made with my system during the past year, but the good results obtained in Messrs. Scrutton's steamer have not been repeated. This statement is absolutely incorrect. No further trial of my system has shown less favourable results than those which have been so conspicuously good in the New York City. During the past year, however, I have been chiefly concerned to allow the continued working of my system in the New York City, under the severe conditions which have been recorded in your columns, to prove its capabilities over a period sufficient to satisfy the most timid or most sceptical as to its inherent merits and its practical efficiency. Ascertaining and confirming data under sea-going conditions, for guidance in more extensive applications, will be, I believe, of more value eventually than making too great haste before such experience is gained.

I have declined, during the past year, the application of my system to the existing boilers of a number of steamers, the owners of which were ready to adopt it, solely because of their proportions of tubes, &c., not being so favourable for the use of air-pressure combustion as other proportions which experience has shown me to be better adapted. With new boilers designed for this mode of working, while still better results may be expected, they should in no case be less favourable than those obtained in the New York City. The boiler in that steamer has now been working continuously under air-pressure for fifteen months, developing about 630 indicated horse-power from about 36 square feet of fire-grate, has never caused an hour's delay for overhaul or repairs, while the boiler continues without the slightest indication of injury in furnaces, combustion chambers, tubes, or any part exposed to the action of the flames. The consumption of coal has been for the last eight months from 9 to 9½ tons per 24 hours, running months together at the lower figure. When any slight increase in the consumption has occurred, the cause has always been found in some outside circumstance, such as unsuitable fire bars leaving too wide air spaces, &c. The same results have invariably been found under the same treatment, with the same quality of fuel, proving that the highiy efficient and economical results obtained in this steamer can with certainty be obtained in any other.

But for the unfortunate loss of the steamer, my system would, however, have had another application during the past year on a scale more than double that of the New York City. This steamer, belonging to a well-known London firm—for which my firm had the boilers made, and would have had them fitted on board early in the summer—was lost on her way home from China to be refitted. In her case two single-ended boilers would have replaced two double-ended boilers, saving space in the former boiler-room for 240 tons of coal. The number of hands required for the new boilers would have also been only about half that required for the previous boilers.

In another case—that of a passenger paddle steamer—the application of my system was prevented from being carried out by accidental circumstances restricting the necessary supply of air for combustion, while the time at disposal did not permit of the required alterations being made.

In a new boiler constructed to work on my system, which was shipped to India in December last, but which was tried under steam and air pressure before leaving, the evaporation from 212 deg. was found to be 12·3 lb. of water per pound of Scotch coal, which cannot be said to be an unfavourable result.

I believe I have stated enough to show that your remarks on the working of my system of combustion during the past year are quite uncalled for, while the further statement as to the certainty of no more vessels bring fitted on my system at present is, to say the least, most reprehensible in a public journalist. How has this certainty been obtained? Has it been by tampering with those in a confidential position in one's employment? In whatever manner this certainty of information, so publicly announced, has been got, I claim an equal publicity for the intimation that the statement is entirely incorrect. There are at present applications of my system of combustion to steamers being made, both at home and abroad, besides negotiations being carried on with some of the largest steamship companies and in the most influential quarters, for the use of my system, but to which it would be out of place to refer to further here.

Before closing, allow me to say a word on the system of forced combustion in use by our Admiralty, the wide application of which in contrast to mine your refer to with so much apparent satisfaction. I have already given elsewhere my views of the delusive character of this system, which may show well on a trial trip of a few hours, if consumption of fuel is entirely disregarded, but which is utterly unfitted for maintaining power at sea under ordinary conditions of working. As it is at sea that these steamers are designed to do their work, it would be well to consider or ascertain how this system fits them for their essential purpose. You mention the Rodney as giving the highest result in power developed by this system on a three hours' trial, this being 17·3 indicated horse-power per square foot of fire-grate. This is about the rate at which my system has been working for the last fifteen months on every-day work at sea. Does any one, however, who knows anything of the effect of working the closed stokehole system of the Admiralty at such an air pressure as is required for a rate of combustion that will give 17 indicated horse-power per square foot of fire-grate, believe that boilers could be worked twenty-four hours at the same rate without serious injury?

I would further ask anyone with experience of this mode of forced combustion, Could boilers be worked on this system at this rate of combustion even three hours without injury if used in the ordinary conditions of boilers in sea-going steamers; that is, with water from two to three times the density of sea water, and with a deposit of scale of more or less thickness on the plates and tubes? This has been the normal condition under which the boiler in the New York City has been worked on my system.

I have not been able to find a single case where a boiler has ever been worked on the closed stokehole system for twenty-four hours at a rate of combustion sufficient to give 16 or 17 indicated horse-power per square foot of fire grate, even with fresh water and boiler perfectly clean. If there has been such a case I would like to have particulars of it. Such cases as the application of this system by Mr. Alfred Holt to the boilers of some of his steamers where the rate of combustion gives from 8½ to 10 indicated horse-power per square foot of grate I do not class among cases of forced combustion; a higher rate can be obtained by natural draught. The consideration of these questions I have asked in regard to the closed stokehole system of forced combustion, and the ascertaining of what I have already accomplished in this department of work will, I believe, lead to a better understanding and a more just appreciation of the respective merits of these systems. JAMES HOWDEN.

Glasgow, January 12th.

[We have commented in another page on Mr. Howden's letter.—ED. E.]

RAILWAYS IN BURMAH, SIAM, ETC.

SIR,—The paper in your last issue upon proposed railways in Burmah and Siam is at once interesting and timely, and your map is valuable, especially to those who are not much acquainted with the general features of these countries. Having been in Rangoon, Moulmein, and Bangkok within the last two years, and having been long in the way of supplying machinery for these places, I appreciate the importance of opening up Upper Burmah, Siam, &c., as markets for British productions. It is well, however, not to reckon on too cheap a rate per mile for the construction of these railways. That from Rangoon to Prome was built at a lower rate than I think it likely that these long extensions will be on an average. The Eastern races, however, are very fond of travelling by railway and also by tramway. One notices this very much in Bombay; and it is the same in Rangoon, where both the railways and the tramways are well patronised. I am well aware from personal experience of the difficulties in India caused by the variations of railway gauge, and no doubt the Rajputana line, for example, would have been much better to have been built of the same gauge as the Bombay and Baroda. Still, for these long lines now proposed into new countries a metre gauge might well be adopted. The great products of these regions, so far as hitherto developed, are rice and teak, and these have been brought down the rivers to the shipping ports. Sometimes, as in the present season, there has been such a want of rain that transport has been seriously curtailed. You state the population of Bangkok at half a million; probably 300,000 would be nearer the mark. The city has only occupied its present situation for a century, having been moved down from its old site to be nearer the mouth of the river, as is not uncommon with Eastern cities. Even three years ago there was no Siamese postal service, the British Consul kindly attending to letters addressed to his care; but now the King has made quite a new departure, and letters are delivered in Bangkok several times daily. His Majesty, who is an autocratic ruler, having learned to speak English, desires to train some at least of his people to the same accomplishment, and has built a spacious academy, called the King's School, and secured the services of an American missionary to conduct it. Thus Siam is slowly moving ahead; it possesses a number of considerably sized saw mills and rice mills, some of the former floating on the river. This is the case also with many of the shops.

Mr. Colquhoun's labours have been most self-denying and energetic, and merit substantial recognition from all Chambers of Commerce and private firms who are engaged in trade with the far East.

ROBERT DOUGLAS.

Dunnikier Foundry, Kirkcaldy, January 11th.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, January 2nd.

THE prospectors after natural gas in Western Pennsylvania and Eastern Ohio placed immense contracts for material to be delivered during the coming season. Over 300 miles of pipe have been contracted for, besides machinery and appliances necessary to build and equip lines from producing wells to manufacturing points. A careful examination of gas territory indicates that the Ohio natural gas field is about 60 miles long and 40 miles wide. A large number of wells will be put down in this section during the coming year. In four counties in Ohio twenty oil wells have already been bored, and five more are being put down. The American production of copper, including 3,000,000 lb. smelted for foreign ore, was 146,000,000 lb. or 26,000,000 lb. more than for 1883, and 51,000,000 lb. more than for 1882. The home consumption was in the last four years, in millions of pounds, 77, 77, 82 and 85 respectively. The exports to Europe were for the same four years 5, 40, 68 and 70 respectively. The stock on hand at the close of each year was 23, 23, 19 and 10 respectively. An improvement in the price of copper is quite probable, and it is believed that some valuable mines which have heretofore been unable to operate by reason of low prices will resume work in January. The iron trade is extremely active and prices everywhere are improving. Crude iron is advancing slowly since a week ago, and large contracts amounting to a quarter of a million tons of crude iron will be placed during January for delivery during the coming season. Large orders for plate, steel rails, and several kinds of iron will also be placed in view of the positive assurance of higher prices later in the season. Wages are also advancing in ore and coal mines, and in some branches of the iron trade not controlled by the Amalgamated Association.

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

(*From our own Correspondent.*)

THE quarterly meetings have been held this week, and additional interest has attached to them from the fact of their being the first meetings of the year. The attendances have been good, large numbers of traders being present from all parts of the kingdom. At the opening meeting at Wolverhampton yesterday—Wednesday—a good deal of curiosity was early manifested to know what course prices were to take in the new year. Some buyers from a distance, taking their cue from the fact of the reduction in ironworkers' wages which comes into operation on Monday, had anticipated a declared change in the price of marked bars. They were soon undeceived, however, since it was early apparent that the list iron houses had determined to make no change.

Marked bars have been re-declared at £7 10s., with 12s. 6d. additional for the Earl of Dudley's make. Besides his lordship there are, however, only at most three firms—namely, Messrs. John Bradley and Co., Messrs. William Barrows and Sons, and the New British Iron Company—who in actual business maintain this standard. Most of the other list houses will continue this year as during last to sell at £7 and £6 10s., the reason being that unless they do so the orders would inevitably pass on to other firms. Bars of a capital quality are plentiful at £6, ordinary bars are £5 10s., and common £5 5s. down to even £5.

The Earl of Dudley's quotations for the new year are: Flats, rounds, and squares, lowest quality, £8 2s. 6d.; single best, £9 10s.; double best, £11; treble best, £13. His lordship's rivet and tee-iron is £10 10s. for single best, £12 for double best, and £14 for treble best. Lowest quality tee-iron is £9 2s. 6d. Angles, strips, and hoops, from 14 to 19 w.g., are £8 12s. 6d., £10, £11 10s., and £13 10s., according to quality. Strips and hoops $\frac{7}{8}$in., of 20 gauge, are £9 12s. 6d., £11, £12 10s., and £14 10s.; while for $\frac{3}{4}$in. a further 20s. per ton is demanded on each quality.

Messrs. William Barrows and Sons quote: Bars, round, square, and flat, £7 10s.; best bars, suitable for chain-making and other purposes, £9; double best, suitable for superior chain bars and the like, £10; plating bars, £8; best angle, tee, and rivet iron, £9 10s.; and double best, £10 10s. Boiler plates the firm quote £9, £10, £11, and £15, according to quality; and sheets, £9 for 20 gauge, £10 10s. for 24 gauge, and £12 for 27 gauge. Hoops they quote £8; best, £9 10s.; and wide strips, £9.

The quotations of the New British Iron Company are:—Lion bars, £7 10s.; Corngreave bars, £6 10s.; best Corngreave plating bars, £7; Lion plating, £8; and best ditto, £9 10s. Best Lion rivet and chain iron is £9; double best, £10; and best Lion turning bars, £11. Double best scrap bars are also £10; treble best, £11; and best charcoal, £11 10s.; best Corngreaves horseshoe bars are £6 10s.; Lion ditto, £7 10s.; and fullered horseshoe, £8 10s. Best Corngreaves angle and tee bars are £7; Lion ditto, £8 5s. to £8 10s.; and best Lion, £9 15s. to £10; window-sash bars are £8 10s. to £9 10s.; oval, convex, and half-round bars, £6 10s.; round cornered and round edged, £7 10s.; and bevelled and headed tire bars, £9.

More interest centred in the action of the sheet makers and some of the other producers of merchant sections in second and third-class qualities than in the action of the list bar houses. The makers indicated had to go through some tough arguments with merchants, galvanisers, and some other buyers, who declined to place orders for the new quarter on any terms except a drop of 2s. 6d., and occasionally even 5s. a ton. The reduction in wages was the ground of buyers' demands. Makers asserted that if even half-a-crown drop were allowed, it would swallow up every bit of the relief which would be afforded them by the lower wages, and they did their best to keep up former rates. When, however, the quarterly meetings are over, there will, I fear, be no alternative but to accept the lower prices if business is to be got.

Merchant sheets—singles—changed hands freely at £6 5s. per ton, galvanising doubles at £6 10s. to £6 12s. 6d., and lattens at £7 10s. to £7 12s. 6d. The proprietary of the Regent Ironworks, Bilston, stood out for better prices than these. They would, they said, accept nothing less than £6 15s. for doubles, and other gauges in proportion. Nearly all the makers complained of a want of specifications; yet at the Regent Works six mills are kept in full swing.

In the galvanised state sheets of 24 g., bundled, delivered Liverpool, were quoted for average qualities about £10 15s.; but there was a good deal of variation about prices, since the qualities now upon the market vary greatly. Thin—best—sheet makers reported good inquiries, and the probability of a large trade in the ensuing three months, in most part on export account. Working-up sheets were quoted £10 to £11, and stamping sheets £11 to £12; but actual realised prices were somewhat less.

Plate-makers were unable to give any but a poor report, and they spoke of the continued severity of the competition of other districts. Tank plates were £7; merchant plates, £7 10s.; common boiler plates, £8; and superior, £8 10s. to £9.

Hoop and strip makers were eagerly on the look out for business, but it was not easy to obtain. When the meetings are well over, however, merchant orders are expected to be received in fair numbers, particularly on colonial account. Good qualities of hoops were £5 15s. up to £6, but common sorts might have been had at £5 5s. to £5 7s. 6d. Common gas strip was £5 up to £5 5s. Fancy irons were very easy. I heard of bedstead ovals being delivered in Birmingham at under £5 per ton.

The native pig market had a tendency towards weakness in Wolverhampton consequent upon the notice for a 5 per cent. reduction, which the makers in this branch have likewise served upon the workmen. But there was no declared change. The all-mine makers re-announced hot-blast sorts at 55s. to 60s., and cold blast at 75s. to 80s. The Lilleshall Iron and Engineering Company was able to report a decrease of stocks, notwithstanding that it continues to blow three furnaces. Native part-mine pigs varied from 37s. 6d. up to 45s., according to mixture. Common cinder pigs were 32s. 6d. up to 35s. for forge sorts. Imported pigs saw more business than natives.

Hematites were pretty firm at 53s. to 54s. per ton. The Tredegar Company quoted 54s. for No. 1, and 43s. for No. 2 forge. Lincolnshire pigs were 41s. to 42s. delivered. North Staffordshire pigs, Apedale brand, 40s.; Northamptons an average of 38s., and Derbyshires mostly 39s., but occasionally 40s. per ton delivered to works. The Thorncliffe — South Yorkshire — brand was 50s. Parcels of pigs changed hands for delivery over the first half of the year. But in none of the departments of the market was business at all brisk.

Minerals were slow of sale. Northampton ironstone is being delivered into the district freely at 5s. 6d. per ton. South Yorkshire cokes are 13s. to 14s. per ton for furnace sorts delivered.

The coal trade is quiet. The supply is in excess of the demand, and prices are unimproved. Forge coal is 5s. to 6s.; mill coal, 7s.; and furnace, 8s. to 10s. Deep house coal mined in the Walsall district is 8s. to 9s. into railway trucks.

I understand that Messrs. Briscoe, Australian merchants, Wolverhampton, have not yet placed their Victorian rail contract, and native steel masters should be encouraged by learning that it is known to be Messrs. Briscoe's wish to place every item of it in this country if it can be done at the same price as that offered by continental manufacturers.

The operations of the "ring" in the shipping trade for the raising of freights to the Australian colonies is having the effect of causing a diminished production at the extensive sheet works in Wolverhampton of Messrs. J. Lysaght. This firm, who from their Bristol galvanising works do a large Australian trade, are greatly concerned at the position, and are attempting to overcome the combination. They are therefore for the present curtailing their shipments, and have put their works on only part time. When fresh shipping arrangements have, however, been made, they will again run full.

The quarterly meeting of the North Staffordshire Coal and Iron Masters' Association was held at Stoke-on-Trent on Monday, Mr. F. Dragge presiding, but little business was done, business being mostly postponed until the Birmingham meeting. Stocks of pig iron, puddled bars, and ironstone were reported to be heavy; but, on the other hand, it was believed that merchants had very little iron beforehand. The advisability of establishing a local pig iron store was discussed, but no decision was come to.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The condition of trade seems to grow worse, and the depression which has characterised the market since the opening of the year has now been intensified by the collapse at Glasgow, where warrants have touched the lowest point since 1852, and the continued downward movement in prices at Middlesbrough. In the present unsettled state of the market any weight of buying in pig iron is altogether checked, whilst in finished iron orders have been held back pending the result of this week's quarterly meetings, the general belief amongst buyers being that prices will have to give way still further. The trade outlook all through continues most discouraging, and "What is to be the end of it?" is the question which is now being generally asked.

The Manchester iron market on Tuesday brought together above the average attendance on 'Change, but scarcely any business was done. The unfavourable reports from Glasgow and Middlesbrough operated against any weight of business being done in pig iron, and prices were scarcely tested. Nominally quotations for local and district brands were unchanged, Lancashire makers still asking 39s. to 39s. 6d., less $2\frac{1}{2}$, with district brands, where they were quoted at all, remaining at about 37s. 6d. and 38s. 6d., less for some of the second-rate brands, and 38s. 6d. to 39s. 6d., less $2\frac{1}{2}$, for the better-class irons delivered equal to Manchester. The tone of the market was, however, unquestionably weaker; Lancashire makers, who are putting into stock, are open to entertain offers at under their quoted rates, and in district brands there are undersellers where there is business to be got. In Middlesbrough iron extremely low prices are reported, but there have been no transactions upon which prices could be really based. For the moment it is difficult to say what prices really are in any class of pig iron, the only definite feature of the market being the general downward tendency of values.

Hematite makers, who in most cases are still fairly well sold, are holding to about 53s. 6d. and 54s., less $2\frac{1}{2}$, for good foundry qualities delivered into this district; there is, however, little or no business giving out, and prices, if anything, are weak, iron in second hands being obtainable at under the rates quoted by makers.

In finished iron, trade has been extremely dull; for delivery into the Manchester district prices have remained on the basis of £5 2s. 6d. to £5 5s. for bars, £5 12s. 6d. to £5 15s. for hoops, and about £6 15s. for local-made sheets. Any orders that buyers have to place have, however, generally been held back pending the Birmingham quarterly meeting on Thursday.

The condition of the engineering trades continues very unsatisfactory, and, leaving out such firms as Sir Joseph Whitworth and Co., who are busily engaged on the manufacture of war material, it is very exceptional where works have orders in hand to keep them anything like fully going. With regard to the reduction of wages, the notices have not yet been posted generally throughout the district, and several of the largest firms have so far taken no definite action in the matter. So far, however, as the Iron Trades Employers' Association is concerned, there is no question as to the reduction being carried out. A meeting of the district committee of the Amalgamated Society of Engineers was held on Tuesday to take into consideration the question of the reduction of wages; nothing definite was decided, the matter being adjourned until complete reports are received from the various places at which notices have been actually posted. There is, however, a very strong feeling not to submit quietly to the reduction.

Messrs. R. and J. Dempster, of Newton Heath, have secured the contract for the iron roof and floors for the new gasworks now being constructed at Wigan. The roof is to be in the form of a semicircular arch, covering the whole span of the retort house, with side bays projecting over railways, which will run on a high level for the purpose of unloading the coal on to the charging floor.

At the special request of the Watch Committee of the Corporation of Manchester, a second and very complete trial of Johnson's patent fire-resisting wire lathing has been made. The special construction of this wire lathing has already been fully described in THE ENGINEER, and it is only necessary to add that for the second trial two double-storey wood panel huts were erected, in one, ordinary wood laths plastered over being used, and in the other the patent wire lathing with a coating of plaster. The huts were filled in the lower storey with inflammable material and fired simultaneously. In a quarter of an hour the flames had burst through the sides of the wood lath hut, in another minute they had penetrated through the ceiling to the joists of the second storey, and in a very short time the whole structure was destroyed. The wire lath hut stood the trial all through, lasting about half an hour, and when the fire was extinguished was practically uninjured, whilst the flooring of the second storey had never even got heated. Another interesting trial was made with the object of showing how the lathing can be utilised in protecting wrought iron girders against the action of fire. In a small shed, built of Johnson's fireproof partition wall, two weighted wrought iron girders, alike in size and section—but one protected with the wire lathing and a coat of plaster and the other uncovered—were subjected for three-quarters of an hour to an intensely hot fire, with the result that the unprotected girder bent to the floor of the furnace, whilst the protected one remained perfectly straight and uninjured.

A meeting of the Manchester Geological Society was held at Wigan on Friday last, and several interesting papers on mining subjects were read. Mr. A. H. Leach had prepared a paper descriptive of improved arrangements which had been introduced at the Brinsop Hall Collieries for screening coal by means of movable screens constructed somewhat on the principle of the movable bars of a mechanical stoker. Mr. Geo. Wild contributed a paper in which he described the operations carried out at the Bardsley Colliery for sinking to a lower mine by means of a tail rope attached to the cages in the existing shaft, and which it was pointed out would enable colliery owners to carry on sinking operations to lower seams simultaneously with the ordinary working of the mines already opened out. The question of safety lamps was again brought before the society, and a couple of new lamps were exhibited which presented features of novelty in dispensing with the usual gauze which has hitherto been considered indispensable in all lamps of this description. One of these lamps, which has been patented by Mr. Jas. McKinless, was exhibited and described by Mr. R. Winstanley, mining engineer, of Manchester. The principal feature of the lamp was that gauze was entirely discarded. The atmosphere for feeding the flame entered above the glass and middle ring of the lamp through a number of very small holes drilled or bored in a belt or band. The diameter of these holes was about $\frac{1}{20}$in., and their length about $\frac{1}{8}$in. The air passed thence between this belt and an inner shield or chimney to the flame. On the outside of the inlet holes, and inside a tin shield or bonnet, there was attached to the middle ring of the lamp another shield which protected the inlet holes from a strong current. On the top of the main cylinder of the lamp was a horizontal plate in which also were a number of small holes, through which the burnt gas and products of combustion escaped. With regard to safety lamps, Mr. Winstanley observed that a theory had been put forward that only sufficient air should be admitted to feed combustion, whilst the outlet should be sufficient to pass the products of combustion freely. In the lamp he had exhibited this theory was reversed, a large quantity of air being admitted whilst the outlet was limited to the greatest nicety. Mr. Winstanley stated that he had made hundreds of experiments with the lamp, both on the surface and underground; he had also used it in fiery mines for gas testing purposes, and it had been subjected to the highest velocities obtainable with the most satisfactory results. The second lamp was exhibited by Mr. Clifford, mining engineer, of Sheffield, and in this the distinguishing feature was that the air strikes the outer skin of the lamp at an angle, and by this arrangement only sufficient to feed the wick enters the flame chamber. Gauze is also dispensed with, but a perforated metal disc, faced with a fusible alloy, is so placed that after long exposure of the flame to gas, or when gas enters the lamp at a high velocity, the alloy fuses, the supply of air is cut off, and the flame goes out.

A very quiet tone prevails all through the coal trade. For house fire consumption the demand is only poor for the time of the year, and other descriptions of fuel for iron making and steam purposes still meet with a very slow sale. Pits are kept on about full time, but in many cases stocks are going down, and although there is no announced alteration in prices, the tendency is in a downward direction.

Barrow.—The position of the hematite pig iron trade is unchanged. The firm tone which has prevailed during the past few weeks is maintained, and although the amount of new business which has been done is not considerable, it is noticeable that the disposition to do a fuller trade is showing itself, not only on the part of home, but continental and foreign users as well. The inquiry on home account is stronger in respect particularly of the increasing requirements of steel makers, who have booked several good orders, which are likely to keep their works better employed during the early part of this year than they were in the year which has just closed. Prices show no alteration. No. 1 Bessemer is still quoted at 45s. per ton net at makers' works, prompt delivery on trucks at works, or f.o.b. at local ports; No. 2, 44s. 6d.; No. 3, 44s.; No. 3 forge, 43s. to 43s. 6d. Forward deliveries can only be negotiated at fuller rates than those which are usually charged, and fully 1s. to 2s. advance is asked on prices for prompt delivery. Except at the rail mills and in the tin-plate department there is no activity in the steel mills in the district, and even in these branches the output could easily be more than doubled. Although it is practically certain that a better trade will be done during this year than during last in both iron and steel, it is equally certain that no such improvement in industrial matters will be established as will furnish employment for the whole of the plant in the district. However, makers are hopeful that at any rate the position will be improved from a demand which will represent a production equal to three-quarters of the whole capacity of the district. Engineers are indifferently employed. A notice of a 10 per cent. reduction has been given to the employés of the Barrow Shipbuilding Company. The North Lonsdale Iron and Steel Company at Ulverston has put in blast another furnace. Messrs. Harrison, Ainslie, and Co., iron ore proprietors, have purchased the Lindale Cote mines in Furness. The shipping trade is much quieter than it has been known for many years.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE Board of Trade returns for December enable us to see the business done in iron, steel, and other industries in which Sheffield is concerned, for the year. For December last the total value of iron and steel exports was £1,588,762, as compared with £1,776,961, and £2,067,090 for the corresponding month of 1884 and 1883;

During last year iron and steel exports amounted to £21,717,136, against £24,496,035, and £28,590,216 for 1884 and 1883 respectively. As compared with December, 1884, the exports of iron and steel for the month show a decrease of £191,199. For the year, as compared with 1884, the decrease is £2,778,899.

Pig iron has fallen from £2,945,223 in 1884 to £2,090,091 in 1885, but the decrease for the month of December is only about £1000. For the year, every market has shown a falling off except British North America, which has slightly increased; but for the month there is a distinct advance in business done with the United States, the values for December in 1884 and 1885 being respectively £15,312 and £33,703. This was accounted for by the fact that a considerable quantity of pig iron was bought by the Americans in the latter part of the month, and caused prices to be firmer at home. It is expected that this demand will be continued during the opening months of 1886.

In bar, angle, and bolt the value exported last year was £1,621,702, compared with £1,942,294 in 1884, and the falling-off for the month has been from £182,876 in December, 1884, to £114,852 last month. Almost every market shows a decrease, the heaviest "drop" being with the British East Indies and Australasia.

Hoops, sheets, and plates were exported last year to the value of £3,288,509. The value in 1884 was £3,693,001. For last December the value was £264,813; for December, 1884, £305,868. The United States particularly, British East Indies, and Australasia are the chief increasing markets. Russia shows a large increase.

Steel rails, which were exported to the value of £2,893,091 in 1884, fell last year to £2,667,567. For December the value was £138,753, as compared with £186,774 for December, 1884. The chief decreasing markets have been Sweden and Norway, Spain and the Canaries, Italy, the United States, Mexico, Brazil, Argentine Republic, Chili, Peru, and Australasia. Trade with the British East Indies has largely increased, both for the month and for the year. The increase for the month is from £39,866 in December, 1884, to £62,260 in December, 1885, and for the year, from £443,287 in 1884, to £891,119 last year. Egypt increased on the year from £31,876 to £122,830; British North America, from £309,881 to £376,807. Railroad material of all sorts was exported last year to the value of £3,896,563, as compared with £4,142,063 in 1884. British East Indies again show a remarkable advance, both on the month and the year. Last year that market took a value of railroad material of all sorts to the amount of £1,503,884—an increase of over £600,000 over 1884. British North America also shows a large increase, but several other important markets have fallen.

Turning to hardware and cutlery, the value sent last month was £246,893, which is about £7000 less than the corresponding month of 1884. The increasing markets for the month are Russia, Germany, France, Spain, and Canaries, the United States, Brazil, Argentine Republic, British North America, and Australasia. Others show a decrease. For the year the value of cutlery and hardware exports was £2,849,459, against £3,142,711 for 1884. The decreasing markets for the year are Russia, Germany, Holland, France, Spain, and Canaries, United States, Foreign West Indies, Brazil, British North America, British Possessions in South Africa, and British East Indies. The only markets showing a increase for the year are the Argentine Republic and Australasia, but it is important to bear in mind that the returns for the last month of the year show a revival of trade in several of the countries where there is a serious falling off during the twelve months.

It is pleasant to observe that business in unwrought steel has taken an upward turn during the last month of the year. The value sent in December was £92,987, as compared with £84,385 in the last month of 1884. France shows a decrease, but the United States, a far more important market, has increased from £20,177 to £29,566. For the year the total value exported was £1,027,583, a falling off of about £100,000 as compared with 1884, the principal decreasing markets for the year being France and the United States. It is expected that the fresh demand for steel for the United States will increase during 1886, and that the next returns will be found still more favourable.

The movement for a reduction of wages in the engineering departments has not yet extended to Sheffield, but it is pretty certain to do so. The amount conceded elsewhere is 7½ per cent. In the edge tool trades the leading firm has intimated to its workmen that they cannot continue to make goods for stock except at a reduction of 15 per cent. on present prices.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE quarterly meeting of the Cleveland iron trade was held at Middlesbrough on Tuesday last. The attendance was good, but business was as quiet as ever, and there were no signs of improvement. For prompt delivery of No. 3 g.m.b., merchants were willing to accept 31s. 1½d. per ton, and some sales were made at that price for delivery extending over next month. Stocks continue to increase, and consumers are waiting to see whether makers will take steps to reduce their output. Under these circumstances the transactions passing are few and insignificant, though prices are lower than ever previously known in the history of the trade. The price of forge iron is fairly well maintained at 30s. 6d. per ton.

There are no inquiries for warrants—the price remains nominally at 32s. 3d. per ton.

Messrs. Connal and Co. had 147,151 tons of Cleveland pig iron in their store at Middlesbrough on Monday last, being an increase of 2760 tons during the week.

Shipments of pig iron from Middlesbrough were poor last month, but are worse this. Only 13,389 tons had been shipped on Monday last, as against 19,557 tons in the corresponding portion of last month. The falling off is principally on account of Scotland, Germany, and Holland.

No better news can be given with respect to the finished iron trade. Only small quantities are inquired for, and prices do not improve. There is, therefore, no immediate prospect of any of the mills now idle being again set to work.

The accountant's certificate for the three months ending December 31st shows that the net average selling price of No. 3 g.m.b. was 32s. 2·99d. per ton. The price for the previous quarter was 32s. 8·61d., or 5·62d. per ton more. Miners' wages will be reduced one-twentieth of a penny per ton.

Messrs. Charles Tennant and Co., of the Hebburn Chemical Works, Hebburn-on-Tyne, are about to sink two bore holes for salt at Haverton Hill, a village on the opposite side of the Tees from Middlesbrough.

The Sunderland Corporation have decided to spend about £7000 upon sea frontage improvements, in order to give work to some of the unemployed workmen in the town.

The operative shipbuilders of the Tyne and Wear are still out on strike against the proposed reduction of their wages. Several meetings have been held by the men, and resolutions have been repeatedly passed in favour of standing out against the employers' terms.

The long-continued depression in trade has resulted in fresh attempts at reduction of the wages of industrial operatives. Taking into account the fact that the necessaries of life are cheaper now by not less than 20 per cent. than they were two years ago, and that wages generally have not fallen proportionately, it is quite certain that workmen are not only not worse off than they were then, but that they are, on the other hand, distinctly better off provided only they are fully and regularly employed. The whole of the distress which undoubtedly exists to an almost inconceivable extent in our manufacturing districts at the present time comes from want of employment, and not from the low remuneration where employment is given. The cry of the workmen might very properly be:—"What is the use of the increased purchasing power of money, seeing that we have no money to spend?" In addition to this cry, they might reasonably add the following, "Give us only full work, at some or any wages which can be afforded, and leave all else to the operation of oconomic laws." Curiously enough, however, the British workman, who is so clever and sensible in many ways, is still almost universally ignorant and prejudiced, and resists truth, when labour questions in which he deems his interests involved are under discussion. He seems then quite incapable of looking beyond his own little sphere of observation, and of taking any but the narrowest view of that. A perusal of the published speeches of such men as Mr. Capper, of Birmingham, and Mr. Trow, of Darlington, both good examples of able operative representatives, will convince any reader that they have not yet mastered the elementary principles of political economy. The key-note of the contentions of working men still is that all reductions of wages should be resisted to the utmost at all hazards, and at all costs, provided the slightest chance of success remains. They ignore or deny the fact that by lower wages a lower cost of production can alone be obtained, and that lower cost of production affords the only means whereby our lost trade can be tempted back. The principle underlying their arguments is always this: "Put us on short time if you must, but pay us rates of wages which will enable us to live during a whole week on the earnings of a portion thereof." In other words, they aim always at more "play" and higher wages during work time, to compensate for inactivity during "playtime." Now the principle on which employers, driven by the necessities of competition, are always acting is exactly opposite to that of the operatives. They are not invariably good economists themselves, but circumstances compel them to enforce economic laws against their operatives, whether they have fully grasped them or not. Every employer knows that shortened hours of labour, with higher wages to compensate, means a doubly-increased cost of production, and that such a state of things would soon bring his works to a stand. He also knows that the workman's idea, that his employer can, and ought to, exercise some control over his customers, is usually quite impracticable, and indicates merely ignorance of the difficulties in the way. He knows that longer hours, with lower rates of wages, constitute the one only chance of re-entering the field of competition and securing a return of prosperity. With longer hours workmen are able to take lower wages, and with lower wages they are willing to work longer hours. With longer hours and lower wages they have less opportunity of spending money in frivolities and sensualities, and less chance of taking part in those agitations which, on the whole, and in the long run, affect detrimentally the interests of all concerned. The pet principle of the British workman, namely, high wages and short hours, which has found its most remarkable embodiment in trades unionism, and the nine hours' movement, is now on its trial with a vengeance. It was all very well whilst this country was far in advance of others in industrial enterprise. Now, however, we have in almost all other countries competitors in our own specialities; and the most telling advantage which, at all events, continental competitors have over us, is that they have never adopted our high wage and short hour system. With their long hours of work and lower wages, many foreign employers can outdo us altogether in cost of production, as far as labour is concerned; whilst their workmen, with less physical strength and energy, make up for all deficiencies by their more provident and less wasteful habits. Seeing that the present tendency is all away from the short hours and high wage system which the British workman has so much belauded, and all towards the continental or long hour and low wage system, which he has so much despised, we may fairly conclude that the latter is, after all, the true and permanent principle, and the former merely an unsound attempt to force economic laws.

The iron shipbuilders of the Tyne and the Wear are seeking to reduce wages to the extent of 12½ per cent. on piecework and 10 per cent. on time work. Notwithstanding that there are many hundreds of vessels laid up idle in British ports, and that shipbuilding in consequence is at a very low ebb, the Tyne and Wear operatives have been actually so foolish as to strike.

The Iron Trade Employers' Association, the headquarters whereof is at Manchester, but whose members are found in every manufacturing town, have given notice of a reduction of 7½ per cent. on all wages within their control. The Glasgow steel makers and the Staffordshire iron manufacturers have done, or are doing, the same; and indeed, all over the country a strong movement is being made to lower wages to such a point as to enable work once again to flow in.

When we read such accounts as that of the meeting of 5000 unemployed persons at Glasgow on the 8th inst., when resolutions were adopted declaring that "great destitution prevailed in that city," and that the "present measures of relief were totally inadequate," and when we consider that that was an indication of the condition of things in every town and every county in the United Kingdom, we are forced to the conclusion that the time has arrived when a change in our notions must be made. The only hope for a quick recovery of British industry seems to be to abandon as soon as possible our much-cherished faith in short hours, which means high cost of production, and to work steadily in the direction of lower wages and longer hours, which will presently result in the increased employment for which the whole industrial world is now so anxiously craving.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE pig iron market has been greatly depressed this week, and prices have been lower than for a period of thirty-three years. During the whole of last year warrants fluctuated between 40s. 8d. and 44s. cash, and since the present year began, the price was repeatedly within a few pence of 40s., but there was an impression that it would not sink below that figure. Indeed, there were not a few holders whose interests forbade them to contemplate such a probability, and therefore, when the prices went down to 39s. 11d. on Tuesday forenoon, there was considerable excitement in the market. The chief reason of this is understood to be that on the 40s. being broken, bankers who have advanced money on warrants would call for an additional margin of security. It may be interesting to recall the fact that in May, 1851, the average price of warrants was 40s.; in June, 39s. 5d.; July, 38s. 9d.; December, 38s.; in January, 1852, it was 36s. 6d.; February, 36s. 3d.; March, 36s. 5d.; April, 36s.; and May, 38s. 1d., from which last price, owing to extra demand from America and a strike among the smelters of iron, it rose to 69s. 9d. before the end of the year. This great advance, of course, gives some hope on this occasion of history again repeating itself, although it must not be forgotten that the circumstances of the trade are different now from what they were in 1852. There was then no mild steel to compete with, and the iron resources of other nations were not nearly so well developed as they are to-day. At the time of the stoppage of the City of Glasgow Bank, which produced a commercial panic in Scotland, warrants touched 40s., and they were never subsequently below that point until to-day.

Business was done in the warrant market on Friday at 40s. 5d. cash, and transactions occurred on Monday at 40s. 4½d. to 40s. 1½d. cash. On Tuesday forenoon the market was depressed at 40s., 40s. ½d., and 39s. 11d. cash, while the cash quotations in the afternoon were 39s. 10½d. to 39s. 11d., and again 39s. 10½d. Business was done on Wednesday at 39s. 10½d. to 40s. 1d. cash. To-day—Thursday—the market was irregular, with business between 40s. 1½d. and 39s. 10½d., closing at 39s. 11d. cash.

The values of makers' iron have been flat in sympathy with warrants. Gartsherrie, f.o.b. at Glasgow, per ton, No. 1 is quoted at 45s. 6d.; No. 3, 43s.; Coltness, 48s. 6d. and 45s.; Langloan, 46s. 6d. and 44s.; Summerlee, 50s. 6d. and 44s.; Calder, 50s. 6d. and 43s.; Carnbroe, 44s. 6d and 42s.; Clyde, 45s. 6d. and 41s. 6d.; Monkland, 40s. 6d. and 38s.; Quarter, 40s. and 37s. 6d.; Govan, at Broomielaw, 40s. 6d. and 38s.; Shotts, at Leith, 46s. 6d. and 46s.; Carron, at Grangemouth, 51s. and 47s.; Kinneil, at Bo'ness, 43s. 6d. and 43s.; Glengarnock, at Ardrossan, 46s. and 42s.; Eglinton, 40s. 6d. and 38s.; Dalmellington, 43s. and 40s.

At an adjourned meeting in Glasgow a few days ago the makers of Siemens steel determined to reduce prices as follows:—Ship plates, by 7s. 6d. a ton; ship angles, 7s. 6d.; boiler plates, 5s.

The shipments of iron and steel goods from Glasgow in the past week embraced two locomotives for Bombay, valued at £5000, and one locomotive and tender for Adelaide at £3500; machinery, £2360; steel goods, £3655; and general iron manufactures, £24,500.

There has been a moderate business in coals in the past week. For shipping qualities of Elland Main coals the inquiry has been poor, but splint coals are in fair request. The shipments of the week included 16,875 tons at Glasgow, 50 at Greenock, 3254 at Ayr, 4361 at Troon, 510 at Leith, 1131 at Irvine, and 2736 at Grangemouth.

The Airdrie miners are now all at work, but those of the Slamannan district declined to return to the pits this week. They have been on strike since the 1st December for an advance of 6d. a day in their wages. At the time they came out, the inquiry for bunker coals, which is the kind mainly produced in the locality, began to decline, and the masters were thus in a position to do without supplies when next to none were required by their customers. It is remarkable that the leaders of the miners, whose counsel they accept and act upon, are nearly always perfectly unacquainted with the circumstances of the trade. On this occasion they could not possibly have chosen a more unfortunate time for the men to go on strike—that is, from the colliers' point of view. At the principal colliery in the district the offices have been shut, and the works entirely closed, and this fact must surely convince the miners that there is no hope whatever of their obtaining an advance of wages at present.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

WHEN the history of the South Wales coal-fields is written few epochs will be more conspicuous than those of 1885. During the year, and on the margin of the new, a great extent of virgin coal has been won, and the whole of the Glamorgan coal-field may be taken practically as proven. The latest "proving" was a few days ago at Penygraig Rhondda Valley, when Messrs. Rowlands and Morgan struck a fine seam, 5ft. in thickness, 45 yards below the 9ft. This would either be the Bute vein or the Lower 4ft.; but at all events the coal is of excellent quality, and it proves that the taking, which is 1300 acres, is an unbroken coal-field on the other side of the fault. This, and the Ynyscadidwg sinking assured, and the Glamorgan coalwinner, having fairly exhausted his old "world," must look ahead for others to conquer, and his new field is unmistakeably Monmouthshire. This year will not pass without vigorous effort in this direction, and I should not be surprised if Sir George Elliott, whose base of operations is so distinctly Newport, does not take the initiative.

This year will also witness the completion of the Swansea Bay and Rhondda Railway, and as Swansea is a day nearer the port of destination than Cardiff—and a day means a round sum in wages, consumption of coal, &c.—there will be some changes in the shipment world which will not augur well for Barry. Given a first-class port, and a free run of Rhondda coal to that port, shippers would scarcely care for a new and insignificant place like Barry, with its exposed entrance. Still, one must wait the completion. That Mr. Walker will succeed in turning out well-constructed docks is unquestionable, and that the Barry promoters, who own two-thirds of the Rhondda coal trade, will do their best, is certain. The only thing I am surprised at is their persistence in hopefulness in the teeth of the warning of the Swansea Bay, the Severn Tunnel, and the Newport improvements.

There is little new in the coal world. Shipments have been irregular on account of the weather, and some damage has been done to coal vessels which ventured out, one going to pieces on the Gower coast, with a loss of most of the hands. In the Channel, from Cardiff to the extreme point, navigation has been difficult. This has told on coal shipments at all the ports. The coal trade generally, notwithstanding this, is fairly good, and settled weather will improve totals. Cardiff last week sent off only 117,000 tons, and Newport, Mon., 32,000 tons in round numbers. Swansea figured better, having sent off close upon 27,000 tons of coal and 6190 tons patent fuel. I am glad to see that this latter industry is moving.

The returns for 1885 are now complete, and I find that Cardiff shows a small increase in coal shipping for the year, and nothing like the large one which the spring opening warranted. In 1884 Cardiff sent 6,987,013 tons. In 1885 the total was 7,132,133 tons, and including bunker coal 9 millions and a-half. The increase of Newport was slight. In 1884 the total was 1,721,512, and in 1885 1,767,791 tons. Swansea showed a falling off. In 1884 the total coal shipments amounted to 946,526 tons, and in 1885, 846,627 tons. Although the total shipments of Welsh coal have not reached the anticipated figure, yet they can but be accepted as satisfactory. The industry is now a colossal one, and merits more notice than it has had.

Compared with every other port for foreign coal shipment, Cardiff maintains its supremacy. This will be seen from a few of the principal items. In 1885 the total foreign coal shipments from Newcastle was 4,363,194; Sunderland, 1,427,170; Newport, 1,767,791. Cardiff, it will thus be seen, is nearly double in foreign coal export over Newcastle.

The returns for iron and steel show that Wales continues to turn out in the bulk a quantity of bars and rails, even though the mills in all directions show a lack of briskness. Thus during 1885 Cardiff shipped 88,522 tons of iron and steel; Newport, 169,844 tons; and Swansea, 3756 tons.

There is not much to chronicle in connection with the iron trade of the week. December totals from Cardiff showed the best of any month in the year, and I only hope January will yield as good a sign. The clearances during the last few days have been to Lisbon, Paysandu, and Trouville.

I am glad to see that Mr. Simons, the solicitor for the coal-owners of South Wales and Monmouthshire Association, takes the same view as I have long advocated in these columns, and that is, that there should be a legal obligation enacted on landowners of coal property to give a fraction per ton towards an accident and death fund for colliers.

The Mardy inquest is progressing; Mr. A. O. Liddell is present from the Home-office. I see that only £3000 have yet been subscribed. The amount needed urgently is £10,000. An illustration of the rashness of colliers was shown this week by a collier having been detected striking a match and lighting his pipe in one of the Aberdare fiery collieries. He was properly punished.

A dispute has taken place amongst some of the Barry men, but is likely to be settled. The Merthyr parish is going in for reservoir improvements at a cost of £10,000.

With the new year the tin-plate trade is going into new tracks and conditions. The combination, so far as the stop week is concerned, is at an end, the association having decided to discontinue it when they held their meeting at Swansea on Saturday last. That Swansea has a right to be regarded as the head-quarters of this industry is shown by the last returns. During the past year 190,000 tons of tin-plates were shipped from that port as against 297,000 tons from the whole of the kingdom. Last week 2900 tons were exported, and several steamers are busily loading.

The Worcester Works, Morriston, are going in for steel bar make. This I apprehend many will follow, and thus be independent of the larger steel works.

Business is not very brisk, and prices are not strong. Coke-plates have been bought for 12s. 9d.; best brands still keep to 14s.; Bessemers keep at 14s. to 14s. 6d.; Siemens, 14s. 6d. to 15s.

The course of the next few weeks' trade will be watched with interest. A large demand is expected from the United States and the colonies, but the question is will buyers not hang back in the hope of getting easier prices?

NEW COMPANIES.

THE following companies have just been registered:—

Canada Works Engineering and Shipbuilding Company, Limited.

It is proposed by this company to take over the engineering, shipbuilding, and other business of the Canada Works Company, Birkenhead. It was registered on the 1st inst. with a capital of £50,000, in £10 shares. The subscribers are:—

	Shares.
A. J. Maginnis, 51, Hartington-road, Liverpool, naval architect	1
*T. C. Clay, 17, Croxteth-road, Liverpool, cotton broker	1
*F. B. Salmon, Liscard, iron manufacturer	1
C. A. Nunan, Birkenhead iron manufacturer	1
*J. J. Potts, C.E., Canada Works, Birkenhead	1
D. Taylor, Oxton, Birkenhead, merchant	1
W. S. Holden, 5, Prince's Park-terrace, Liverpool, solicitor	1

The number of directors is not to be less than three nor more than seven; qualification, fifty shares; the first are the subscribers denoted by an asterisk and Mr. William Heap. Each ordinary director will be entitled to £2 2s. for every meeting of the board he may attend. Mr. J. J. Potts is appointed managing director.

Beacon Patent Invulnerable Lock and Fireproof Safe Company, Limited.

This is the conversion to a company of the business of a safe and lock manufacturer carried on by Mr. Richard Davies, at Sedgley, near Dudley. It was registered on the 1st inst. with a capital of £5000, in £1 shares, with the following as first subscribers:—

	Shares.
R. Davies, Sedgley, safe and lock manufacturer	50
T. H. Lyon, Guildford-street, Birmingham	50
A. D. Field, 88, Coventry-road, Birmingham, jeweller	25
J. G. Stratton, 14, Temple-street, Birmingham, accountant	5
G. Edwards, 367, Nechells Park-road, Birmingham, accountant	1
C. Prescott, Handsworth, Birmingham, accountant	1
E. Mallard, Birmingham, solicitor	5

Registered without special articles.

Brangwin and Co., Limited.

This is the conversion to a company of the business of manufacturer of garden, park, and railway seats, horticultural implements, domestic appliances, and of tin and iron plateworker, gas and hot water engineer and hardware merchant, carried on by Mrs. Eliza Russell Brangwin, under the style of E. Brangwin and Co., at the Paragon Works, Richmond-road, Hackney. It was registered on the 5th inst. with a capital of £2000, in £5 shares. The subscribers are:—

	Shares.
J. Williams, 188, Brooke-road, Clapton, commercial traveller	1
G. Wright, Kingston-on-Thames, Baptist minister	1
T. B. Grundall, 129, Cornwall-road	1
S. P. Beeton, 28, Cheapside, warehouseman	1
R. Hincks, 12, Tavistock-road, Croydon, civil servant	1
W. Curtis, Great Marlow, farm steward	1
R. A. Brangwin, 77, The Dane, Margate, colonial buyer	1

Registered without special articles.

Fire Resisting Paper, Ink, and Paint Company, Limited.

Upon terms of an agreement of the 31st ult. this company proposes to purchase the letters patent No. 941, dated 20th February, 1883, granted to Alexander Melville Clark, as agent for Gaspard Meyer, for improvements in the manufacture of uninflammable and incombustible products for writing and printing purposes, for paperhangings, stage scenery, modelling, moulding, for covering electric wires and cables, for withstanding the action of acids, for decorating ceramic and other ware, and for other purposes. It was registered on the 4th inst. with a capital of £50,000, in £1 shares. The purchase consideration is £5500 in cash and £20,000 in fully-paid shares. The subscribers are:—

	Shares.
T. H. T. Rogers, 3 and 4, Great Winchester-street, solicitor	1
V. M. Elkington, 54, Windsor road, Holloway, clerk	1
A. R. Hanson, 111, Sebert-road, Forest-gate, clerk	1
E. B. Woodford, 27, Albemarle-street, secretary	1
H. W. Wheeler, 49, Cannon-street, actuary	1
W. Barry, 55, Chancery-lane, engineer	1
P. S. Bailey, 10, College-terrace, Belsize Park	1

The number of directors is not to be less than three nor more than five; the first are Messrs. A. Ritchie Leask, William Leigh Bernard, and Edward Jennings. Remuneration, £2 2s. to each director for every board or committee meeting attended; also one-tenth of net profits in each dividend period in which at least 7½ per cent. is paid.

Stave Sheet Barrel Company, Limited.

This company was registered on the 31st ult. with a capital of £20,000, in £5 shares, to work and develope Andrew's patents for cask or barrel making. The subscribers are:—

	Shares.
Charles Fox, 2, King's Arms-yard, chartered accountant	1
*F. Andrew, St. George's Works, Rotherhithe, cooper	1
J. W. Woodthorpe, 1, Leadenhall-street, chartered accountant	1
E. E. Fox, North Finchley, auctioneer	1
Edwin Fox, jun., 99, Gresham-street, auctioneer	1
F. W. Francis, 18, Drummond-road, S.E., engineer	1
A. E. Humphris, 2, King's Arms-yard, clerk	1

The first directors are Messrs. William Bacon, of 20, Arundel-street, August Zumbeck, 69, Mark-lane, and F. Andrew. The purchase consideration is £1500 cash and £9500 in fully-paid shares.

Fisher and Randall, Limited..

This company was constituted by deed of settlement on the 23rd ult., and was registered on the 5th inst., as a limited company, with a capital of £150,000, in £50 shares. It proposes to acquire the business of merchants, commission agents, shipowners, &c., carried on by Messrs. William Henry Randall, William Francis, and Earle Hoare, trading as Fisher and Randall, at Manchester, Liverpool, and elsewhere in Great Britain, and at Marseilles, and as Randall and Fisher at Freetown, Sierra Leone, and elsewhere in Africa. Three thousand shares have been taken up, and £40 has been paid upon each. The members are:—

	Shares.
*William Henry Randall, 61, George-street, Manchester, merchant	1405
*William Francis Fisher, Ashton-upon-Mersey, merchant	1405
*Earle Hoare, jun., Albany, Liverpool, merchant	186
G. F. Fisher, Cheadle, Chester	1
Earle Hoare, Waterloo, Liverpool	1
J. Wheeldon Smith, 132, Upper Brook-street, Manchester, cashier	1
Henry Gould, Cheetham, Manchester, merchant's buyer	1

The number of directors is not to be less than three nor more than seven; qualification, £5000 of the capital. The first three subscribers are appointed directors and managers at salaries of £500 per annum each.

Montreal Chemical Fertiliser Works, Limited.

This company proposes to acquire properties in Canada or elsewhere, producing copper, phosphate, or other minerals, and to carry on business as manufacturers of sulphuric acid, super-phosphate, and of other chemical produce. It was registered on the 31st ult. with a capital of £150,000, divided into 129,375 preference shares and 20,625 ordinary shares of £1 each. The subscribers are:—

	Shares.
H. J. Anderson, 4, Fenchurch-avenue, West India merchant	1
W. G. Cowper, 1, Fenchurch-avenue, commission merchant	1
Walter Bird, 7, East India-avenue, merchant	1
G. E. Church, Dashwood House, contractor for public works	1
F. J. Falding, 449, Strand, engineer	1
A. J. Lambert, 4, Copthall-buildings, merchant	1
C. Prickett, 98, Frederick-street, Barnsbury, clerk	1

The number of directors is not to be less than three nor more than seven; qualification, 250 shares; the subscribers are to appoint the first and are to act *ad interim*; remuneration, £700 per annum, with an additional sum of £300 for each 1 per cent. dividend in excess of 15 per cent.

Farnworth and District Mineral Water Manufactory and Bottling Company, Limited.

This is the conversion to a company of the business of mineral water manufacturer carried on by Martha Ann Brierley, at Cawder-street, Farnworth. It was registered on the 31st. ult. with a capital of £1500, in £5 shares. The subscribers are:—

	Shares.
J. Leigh, Farnworth, Lancaster, licensed victualler	5
J. W. Laynor, Stoneclough, brewer	5
J. Grimshaw, Farnworth, hotel manager	5
T. Davies, Farnworth, hotel manager	5
W. Thornley, Little Lever, licensed victualler	5
G. Loynd, Moses-gate, licensed victualler	5
J. Green, Kearsley, beerseller	5
J. Leach, Farnworth, agent	5
T. Walton, Moses-gate, licensed victualler	5

Registered without special articles.

A USEFUL INVENTION FOR STEAMSHIP CAPTAINS.—A board of naval officers tested the Baird annunciators on board the Fish Commission ship Albatross, at Washington, on the 19th inst. The object of the invention is to indicate in the pilot house or elsewhere the fact as to whether the engines of a ship are in motion, and if so in what direction they are moving. This is accomplished by a pneumatic pressure acting upon the vanes of a delicately constructed and sensitive fan which is geared to and revolves a miniature crank upon a 6in. dial in the pilot house. The air is compressed by an 8in. blower belted to the shaft of the main engine, and is arranged to blow when the engine goes ahead, and to exhaust when the engine backs. A 1in. lead pipe connects the blower with the annunciator. The board reported favourably on the machines and recommended their adoption by the naval service. The machines appear to be absolutely certain in their action and are very prompt. On board a twin screw ship the annunciators are invaluable; they not only relieve the commander of the task of remembering which engine is moving, but give him warning of any mistake that has been made and ample time to correct it. A number of annunciators may be attached to branch pipes and must necessarily all indicate alike. — *Army and Navy Register.*

WHAT IS THE TRUTH ABOUT EMIGRATION. — Owing to the number of complaints made by working men, both in the Colonies and in England, about the state of the labour market in the districts to which emigration is being encouraged, a committee has been formed with a view to opening up inquiry into the whole subject of emigration. It is felt by the promoters that the true state of the case ought to be known, so that philanthropic people may be prevented from supporting schemes that are not likely to be successful, and that workers may be saved the trouble of crossing the ocean, only to find matters as bad as they were at home. It is desirable to know:—(1) What is the exact state of the labour market in the Colonies; (2) what workers are really required, and stand a chance of finding employment if they emigrate; (3) what accommodation is provided for emigrants on the voyage and at the depôts; (4) the actual results of sending young females to the Colonies. In order that the subject may be fully and fairly dealt with, a conference will be held towards the end of February, 1886, at some central hall, to which will be invited: (1) Emigration agents; (2) promoters of emigration schemes; (3) returned emigrants; (4) delegates of trades' unions; (5) delegates of labour societies. To assist the members of the conference, it is desirable to obtain all the information possible, and the committee hereby invite communications from all who are in correspondence with friends at present in the Colonies, from persons who have returned, and from any who possess special facilities for getting reliable intelligence on the state of the Colonial labour market. All communications may be sent to the secretary, Mr. W. Blundell, 14, Camden-passage, Islington, or to any member of the committee. The committee will be very grateful to any managers of schools who will kindly lend their rooms for a lecture on emigration.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

5th January, 1886.

127. PURIFYING FLOUR and MIDDLINGS, W. Weaver, Belfast.
128. SUPPLYING AIR to GAS BURNERS, B. H. Thwaite, Liverpool.
129. HEATING SMOOTHING IRONS for LAUNDRY PURPOSES, J. Barlow, Rochdale.
130. STEAM BOILERS, G. H. Corliss, London.
131. STEAM ENGINES, G. H. Corliss, London.
132. PICKERS for LOOMS, T., J., and G. Shorrock, Brimscall.
133. BOX for CONTAINING POWDERED MATERIAL, G. J. F. Tate, London.
134. AUTOMATIC FEEDING of STEAM BOILERS, C. S. Madan, Manchester.
135. LUGGAGE CARRIERS for BICYCLES, J. A. Lamplugh, Birmingham.
136. ELECTRICAL TRAMWAYS, R. E. B. Crompton and J. H. F. Soll, London.
137. BALL'S SELF-ACTING PASSENGER ANNOTATOR for Tramcars, A. B. Ball and A. Pilley, Sheffield.
138. COVERINGS for ROLLERS USED in TEXTILE MACHINERY, S. Bergstresser, Manchester.
139. RAILWAY JUNCTION TICKET STAMPS, C. White, Bath.
140. BUTTON FASTENERS for BOOTS, &c., I. J. Saunders, France.
141. PERAMBULATOR HOODS, W. Hatchman, London.
142. CROSS VENTILATION of SEWERS, J. G. Brown, Sunderland.
143. CONSTRUCTION of HOLLOW LINKS for CHAINS, J. Satchwell, Birmingham.
144. CONICAL PAPER TUBES, T. Craven, S. Gill, and C. Forrest, Bradford.
145. WHIP SPURS, J. E. Whiting, India.
146. FIRE-PROOF MATERIAL for INTERNAL SURFACES of BUILDINGS, J. Ferguson, Carlisle.
147. INJECTORS for RAISING LIQUIDS, &c., C. S. Madan, Manchester.
148. STOPPERED BOTTLES, J. A. Schofield and J. Brierley, Manchester.
149. FURNACES, W. Begg, Manchester.
150. ALUM and SULPHATE of ALUMINA, T. Robinson, Glasgow.
151. GAS BURNERS, R. M. Deeley, Derby.
152. GAS ENGINES, H. Sumner, Manchester.
153. DISCHARGING WATER from FLUSHING CISTERNS, O. Elphick, London.
154. DYNAMO-ELECTRIC MACHINES, H. J. Allison.—(*E. Thomson, United States.*)
155. WATCH-GUARDS, C. Cashmere and F. Banning, London.
156. WHIPPING DRUM for HOISTING COAL, &c., J. Wigham, London.
157. CURING SMOKY CHIMNEYS, J. Bennison, London.
158. METALLIC PISTONS, J. Conlong, London.
159. TREATMENT of METALLIC CHLORIDES, J. E. Bennett, London.
160. PORTABLE TRIPOD STANDS, H. G. Spearing, Cheltenham.
161. APPARATUS for the RECEPTION of COIN, C. H. Russell, London.
162. SCATTERING DRY DISINFECTING MATERIALS, B. A. Dryer, London.
163. WEIGHING GRAIN, A. C. Ashby, London.
164. ORNAMENTING FABRICS, A. H. Reed.—(*F. Mencke and A. Pottier, United States.*)
165. FURNACE BARS, J. Naysmith, Glasgow.
166. PIANOFORTES, D. F. Downing, London.
167. DUPLEX GRADUATED ARTIFICIAL LIGHT, P. V. Fantini and S. J. Muir, London.
168. VESSELS ADAPTED for SUBAQUEOUS USE, R. Watkins, London.
169. AUTOMATIC DUPLEX COUPLINGS for RAILWAY TRUCKS, &c., H. S. S. Copland and J. C. Gilmour, London.
170. HYDRO-PNEUMATIC ACTION for WORKING the MECHANISM in ORGANS without the use of a PUMP, J. Earsden, London.
171. VELOCIPEDE, A. S. Bowley, London.
172. ARCHERY BOWS, A. Z. and J. B. Petzl, London.
173. CARTRIDGES for FIRE-ARMS, H. F. Clark, New York.
174. PRINTERS' QUOINS, G. A. Page.—(*H. Enich, Germany.*)
175. VENTILATORS, &c., H. J. Haddan.—(*J. S. Wethered, U.S.*)
176. ILLUMINATING GAS, H. J. Haddan.—(*J. S. Wethered, U.S.*)
177. HOLDERS for PENCILS, &c., M. Sachs, London.
178. FASTENERS for SHEETS of RAILWAY TRUCKS, &c., J. Wilkinson, London.
179. CONNECTING DOOR KNOBS to the ROSES, R. G. Evered, London.
180. PROCESS for PRODUCTION of SULPHUROUS ACID GAS, J. and J. Addie, Glagow.
181. HEATING, &c., FIBROUS and TEXTILE MATERIALS, A. L., A., and W. Cochrane, Glasgow.
182. LAMPS for BURNING OILS, A. D. Turner and W. Flatau, London.
183. CONSUMING SMOKE from FURNACES, F. White, London.
184. INHALER, H. D. Cushman, London.
185. ARTIFICIAL TEETH, H. C. Register, Philadelphia.
186. DIRECT-ACTING STEAM ENGINES, H. E. Newton.—(*C. C. Worthington, United States.*)
187. MOTOR ENGINES, J. Watts and H. E. Smith, London.
188. SECURING METAL SASH BARS in ROOFS, &c., J. D. Mackenzie, London.
189. DRYING APPARATUS, L. J. Cadwell, London.
190. SLOTTING MACHINES, D. Wilson, London.
191. TIRES for WHEELS of CARRIAGES, &c., J. U. Burt, London.
192. STEAM BOILERS, J. H. Hopwood, London.
193. WHEELS for VELOCIPEDES, &c., W. P. Hoblyn, London.
194. MULTITUBULAR STEAM BOILERS, W. J. Fraser and F. S. Morris, London.
195. TEA-POTS, &c., F. Winkle and W. Wood, London.
196. BICYCLES, J. de Buigne, London.
197. INDICATING the ESCAPE of GAS, G. F. Redfern.—(*J. Lacoste, France.*)
198. GLOBES for GAS and other LAMPS, S. Falk, London.
199. PURIFYING AIR, H. F. Horsnaill, London.
200. MECHANICAL TELEPHONES, P. Ewens, Earley.
201. BURNING SEWER and IMPURE AIR, &c., R. W. Hellyer, London.
202. FLYERS for SPINNING MACHINES, C. Mauris, London.
203. CIGARS, &c., G. Rubin, London.
204. HANDLES of HAND BAGS, &c., B. B. Hicks.—(*P. Sternberg, Germany.*)

6th January, 1886.

205. PREVENTING the BREAKAGE of CRANES, &c., W. Sterling, jun., and T. Swan, Manchester.
206. PREVENTING ACCIDENTS while CLEANING WINDOWS, B. Harris, Newcastle-on-Tyne.
207. MOTORS, E. Butterworth, Rochdale.
208. APPLYING POLISH to WATER-PROOF FABRICS, I. Frankenburg, Manchester.
209. SHIP or MARINE PROPULSION, R. Hughes and W. Griffin, Bilston.
210. GULLEYS, J. R. Hargreaves, Halifax.
211. PRODUCTION of PIECE DYED GOODS, J. C. Munn, Manchester.
212. WICKET-KEEPING GAUNTLETS, A. Shaw and A. Shrewsbury, Nottingham.
213. COUPLING and UNCOUPLING RAILWAY VEHICLES, W. Herald, Godley.
214. COLLECTING COCKLES, &c., M. E. West, Grange-over-Sands.
215. WINDOW SASH FASTENERS, C. Homer, Birmingham.
216. SHANKED BUTTONS, J. P. Turner and W. Spittle, Birmingham.
217. CANISTERS for CONTAINING GUNPOWDER, &c., F. W. Ticehurst, Birmingham.
218. AUTOMATIC VALVES for SUPPLYING WATER to BOILERS, &c., J. Anderson, London.
219. EXPANSION COUPLER, R. W. Abercrombie, Glasgow.
220. FIRE-BARS, E. Schmidt, Liverpool.
221. SELF-ACTING VALVE, J. P. Marsh, Liverpool.
222. PESSARIES and BELTS thereof, M. J. Hall, London.
223. MECHANISM for HATS or HELMETS for HOLDING them CLOSE to the HEAD, J. Williams, Liverpool.
224. COMBINATION SHAVING APPLIANCE, S. Phillips, Lower Edmonton.
225. COUPLING HEAVY GOODS TRAFFIC on RAILWAYS without GOING BETWEEN the TRUCKS, W. W. Askew and W. O'C. Clark, London.
226. COUPLING ARRANGEMENT for RAILWAY WAGONS, J. P. Waldie, Edinburgh.
227. BI-CARBONATE of SODA and SODA ASH, N. Matheson and J. Hawliczek, London.
228. LATTICE BRIDGES, G. G. M. Hardingham.—(*La Société Anonyme de Sclessin, Belgium.*)
229. TREADS of STAIRS, &c., J. H. and W. Gooding, London.
230. SOUNDING BOARD for PIANOFORTES, E. Bishop, Chalk Farm.
231. ARCHED SOUNDING BOARD BRIDGES for PIANOFORTES, E. Bishop, London.
232. ARTISTICALLY DISPLAYING FLOWERS, &c., E. H. Straw, London.
233. TUNNELS, T. Newman, Ealing.
234. CLOCKS, &c., J. W. Gordon, London.
235. CLEANING WINDOWS, J. Frazer, London.
236. COLLECTING and CHECKING MONEY, A. Page, London.
237. METAL RAILWAY SLEEPERS, E. P. Davis, London.
238. BOX IRON, G. F. Redfern.—(*P. de Mol, Belgium.*)
239. HAT BOX and DRESSING CASE, A. W. Buckingham, London.
240. REGENERATIVE GAS LAMPS or LANTERNS, S. Chandler, sen., S. Chandler, jun., and J. Chandler, London.
241. RENDERING INVISIBLE the ESCAPE STEAM of TRAMWAY, &c., LOCOMOTIVES, R. C. Parsons, London.
242. CONVERTIBLE TANDEM or SINGLE VELOCIPEDES, T. G. Crump, jun., and S. E. Waldegrave, London.
243. ORNAMENTAL INDIA-RUBBER WATERPROOF FABRICS, G. C. and S. L Mandleberg and H. L. Rothband, London.
244. MILLSTONES, E. Edwards.—(*M. Rhor and L. Lamblé, France.*)
245. STIRRUPS, E. Edwards.—(*L. F. A. Bourget and A. E. N. Decarpentry, France.*)
246. FASTENING BOXES, J. T. Weihe, London.
247. WATER WASTE PREVENTER, R. D. Bowman, London.
248. ADVERTISING MEDIUM, H. H. Leigh.—(*F. Pellas, Italy.*)
249. CASTING STEEL, MOULDS, &c., M. P. Hayes, London.
250. STILLING and TAPPING CHAMPAGNE, &c., F. Walter, London.
251. GENERATING ELECTRICITY, S. Vyle, London.

7th January, 1886.

252. GUN CARRIAGES, O. Jones, London.
253. PROPELLING SHIPS, R. T. Turnbull.—(*I. Plimmer, New Zealand.*)
254. WOOD PLANING MACHINES, J. Hamilton, Derby.
255. STONE or CONCRETE PIERS, &c., W. Gallon, Sheffield.
256. CANS for CONTAINING YARNS, &c., L. Bridge, Halifax.
257. FRICTION PLATES of YARN SIZING MACHINES, P. Brimelow, Halifax.
258. RING SPINNING FRAMES, J. Elce, Manchester.
259. MOUNTS for INKSTANDS, CRUETS, &c., C. T. Smith, Birmingham.
260. METALLIC FENDERS, J. and F. S. Turner, Dudley.
261. HEATING WATER, T. Fletcher, Manchester.
262. GOVERNORS for TRAM and LOCOMOTIVE ENGINES, A. D. Davies, Aston.
263. COMBINED SPRING and SADDLE for BICYCLES, W. Maher, Dublin.
264. WOOL COMBING MACHINES, W. Terry, Halifax.
265. FRAME for PACKING SEAL SKIN, &c., B. Shaw, Huddersfield.
266. SMOKE CONSUMING FURNACES, R. and W. Wainwright, London.
267. COMBINATION of APPLIANCES for SMOKERS, F. Plaister, London.
268. BOTTOM WORKS of COUNTER WEIGHING MACHINES, W. J. Hubbard, London.
269. PIPE TONGS, WRENCHES, and SPANNERS, J. H. Barry, London.
270. TRACTION ENGINES, A. J. Boult.—(*V. Kroh, Austria.*)
271. DRIVING GEAR of BICYCLES, &c., C. E. G. Simons, Merthyr Tydfil.
272. SHEARS, W. W. Slack, Sheffield.
273. THIMBLES, J. Hickisson, London.
274. TRAPS or SYPHONS for URINALS, &c., S. Jackson, Halifax.
275. PENCIL LEAD CASES and HOLDERS, O. Bussler, London.
276. STEERING SHIPS, R. T. Turnbull.—(*I. Plimmer, New Zealand.*)
277. OBTAINING POWER by means of AIR and WATER, &c., C. J. Eyre, London.
278. SPHERICAL FOOTBALL POUFF, A. Fratino, London.
279. WRITING CABINETS, T. Robb, Glasgow.
280. STEAM BOILERS, J. Fyfe, Glasgow.
281. GALVANIC BATTERIES, J. Hosking, London.
282. SECURING SHIRT COLLARS, P. and J. P. McIntyre, A. Hogg, and H. J. Marsh, London.
283. ELECTRO-MECHANICAL GOVERNOR, O. E. Woodhouse and F. L. Rawson, London.
284. ROWING or PROPELLING BOATS, &c., J. E. Holloway, London.
285. OBTAINING and APPLYING MOTIVE POWER, P. Mutter, Hamilton, Ontario.
286. FITTINGS of RUDDERS of SHIPS, &c., C. N. Nixon, London.
287. RECEPTACLE for CONTAINING COINS, &c., F. L. Harford, London.
288. SUSPENDED WICKLESS LAMPS, J. Cox, London.
289. HAND-WORKED GRASS CUTTER and CLIPPER, R. Parker, London.
290. ELEMENTS for PRIMARY BATTERIES, H. Woodward, London.
291. VEGETABLE IVORY BUTTONS, E. Bermen, London.
292. ARTIFICIAL FUEL and FIRE-LIGHTERS, A. Gutensohn, London.
293. STEAM ENGINE VALVE GEAR, E. Tincknell, London.
294. SAFETY LAMPS, E. M. Hann, London.
295. CORNETS, H. H. Lake.—(*C. Mahillon, Brussels.*)
296. LAMPS for BURNING MINERAL OIL, H. H. Lake.—*Messrs. Lempereur and Bernard, Belgium.*)
297. NEUTRALISING the OILS used in COLOUR PRINTING, W. Boulton and J. Davenport, London.
298. SELF-FEEDING and SMOKE-CONSUMING FURNACES, C. T. Colebrook, London.

8th January, 1886.

299. ELECTRIC INDICATORS for BELLS, J. C. Revill, Nottingham.
300. LAMPS, W. T. Webber, Birmingham.
301. JOINING RAILWAY and TRAMWAY RAILS, J. M. Burke, Dublin.
302. JOURNAL, SHAFT and AXLE BEARINGS, W. K. Tapp, Leeds.
303. ELEVATOR CASES for GRAIN, A. Thompson and E. Scholes, Manchester.
304. PERFUME BELLOWS, A. Pickard, Shipley.
305. OPENING AERATED LIQUID BOTTLES, W. Sullivan, Dublin.
306. STOP MOTION for SPINNING MACHINES, G. Kirkman, Halifax.

307. LAVATORIES, A. G. White, Liverpool.
308. AIR CHAMBER BRIDGE, Messrs. P. and S. Hoole, Stockport.
309. TUCK FOLDERS, W. Matthews and A. G. Easton, London.
310. GAS STOVES for COOKING PURPOSES, A. Thorns, Leeds.
311. TELEPHONES, R. H. Ridout, London.
312. MAKING INLAID STICK, &c., HANDLES, E. Hahn, London.
313. TREATING ROPES, R. Troitzsch, Liverpool.
314. SHIRTSTUDS or SCARF FASTENERS, W. S. Boult, London.
315. DRYING GRAIN, W. P. Thompson.—(*H. R. Foote, United States.*)
316. ROTARY SPHERICAL ENGINES or PUMPS, T. Mudd, Liverpool.
317. LEAD PENCIL CASES and HOLDERS, O. Bussler, London.
318. BLASTING APPLIANCES S. H. Emmens, London.
319. STOPPERS for BOTTLES and JARS, S. H. Emmens, London.
320. HOOKS and FASTENERS for CLOTHING, A. J. Wheeler, London.
321. ELECTRIC BATTERY, G. J. Atkins, London.
322 TREATING WOOL to DESTROY BURRS, &c., W. H. Maitland, London.
323. CHARCOAL BOX IRONS, J. and J. Whitehouse, London.
324. MILLS for GRINDING GRAIN, &c., S. B. Bamford, London.
325. CARRYING ARTICLES SECURED with STRING, H. F. Dessen, London.
326. PREPARING LANOLIN, &c., from WASTE LIQUORS of WOOL WASHING ESTABLISHMENTS, C. D. Abel.—(*The Fabrik Chemischer Produkte Actien Gesellschaft, Germany.*)
327. TRAMWAY and LOCOMOTIVE ENGINES, A. Greig, London.
328. ADVERTISING, J. Hickisson, London.
329. ADJUSTABLE SIEVE, A. J. Austin, London.
330. MALT-CLEANSING MACHINE, L. A. Groth.—(*J. Knogler, Germany.*)
331. MACHINERY for MAKING FISHING NETS, A. J. Allan, Glasgow.
332. KNOT to be used in FISHING NETS, A. J. Allan, Glasgow.
333. APPARATUS for DISINFECTING CLOTHES, &c., G. C. Fraser, London.
334. LOOMS, G. Kirk, London.
335. VOLTAIC BATTERIES, D. G. FitzGerald, London.
336. CLASPS for CORSETS, W. R. Lake.—(*F. F. Delpy, France.*)
337. ELECTRICAL TRANSMISSION of SOUND, W. R. Lake.—(*J. W. Bonta, United States.*)
338. PUNCHING, SHEARING, &c., MACHINES, W. Whited, London.
339. SUPPORTING CANDLE SHADES, J. F. Marchant and J. S. Browne, London.
340. MAKING COMPOUND ARMOUR PLATES, H. C. S. Dyer, London.
341. EXTRACTING COUPLING BOLTS, S. W. Alley and A. Kellar, London.
342. PRODUCING REALISTIC REPRESENTATIONS of the INTERIORS of MINES, C. Wells, London.
343. APPARATUS for GETTING COAL, C. Wells, London.
344. CONSTRUCTION of CONNECTING-ROD ENDS, C. Wells, London.
345. STUFFING BOXES, C. Wells, London.
346. CLOSED FIRE-PLACES, C. Wells, London.
347. WATER-GAUGE GLASS FITTINGS, C. Wells, London.
348. TWIST DRILLS, C. Wells, London.
349. WATCHES, C. Wells, London.
350. LOCK-NUTS, C. Wells, London.
351. CANDLES, C. Wells, London.
352. MULTIPLE-WICK CANDLES, C. Wells, London.

9th January, 1886.

353. TENNIS SHOES, H. Law, Northampton.
354. ABSORBENT, W. Jowett, Manchester.
355. ELECTRIC MEASURING INSTRUMENTS, S. Evershed, Kenley.
356. STARCHING MACHINES, J. McCracken, Belfast.
357. VELOCIPEDES, J. H. Dearlove and H. Thresher, London.
358. PRODUCING PICTURES on POTTERY-WARE, &c., D. Lawless, London.
359. SCOURING, &c., WOVEN or FELTED FIBRE, F. W. Hudson and F. W. Schroëder, Leeds.
360. WRINGING or SQUEEZING WOVEN or FELTED FIBRE, F. W. Hudson and F. W. Schroëder, Leeds.
361. LAMPS for CARRIAGES, W. Webber, Birmingham.
362. MACHINERY for WASHING, &c., W. Giffard, Salford.
363. MAKING CUT or UNCUT PILE FABRICS, J. T. and W. W. L. Lishman and W. R. Bootland, Silsden.
364. SASH FASTENERS, J. T. Hyde, Leeds.
365. SECURING STOPPERS of BOTTLES, Deykin and Sons, Birmingham.
366. WOOD and METAL TURNING LATHE, J. W. Dulston, Rochdale.
367. COMMAND of SWELL PEDAL of ORGANS, J. Morland, Waterford.
368. TIN or TIN-PLATE and other METAL-BOXES, G. F. Griffin, London.
369. SHIPS of WAR, Sir E. J. Reed, London.
370. STOVE SCREENS, A. Mullord, London.
371. HOLDING MATCHES, E. Ferrari, London.
372. LAMPS, E. A. Rippingille and H. Priest, London.
373. CONSTRUCTING HARBOURS, &c., H. S. S. Copland and J. C. Gilmour, London.
374. TOBACCO PIPES, H de B. Hovell, Portsmouth.
375. NUT SHAPING, V. Rhodes, London.
376. SNOW SHOE for HORSES, E. S. Copeman, London.
377. CENTRIFUGAL DRYING MACHINES, E. Edwards.—(*A. Carrière, France.*)
378. BUCKLES for STRAPS, J. M. Stringfellow, Liverpool.
379. SELF-REGISTERING WEIGHING MACHINES, C. Hiltermann, London.
380. COMPRESSING AIR, G. Epstein, London.
381. RAILWAY SIGNALLING APPARATUS, W. Griffiths and E. T. R. Brittain, London.
382. BURNING OILS in STEAM BOILERS, J. Watson, London.
383. CLEANER for TOBACCO PIPES, J. F. Forth, London.
384. ADJUSTABLE BOTTLE HOLDER, T. White and E. S. Wells, London.
385. GAME for TEACHING MUSIC, H. M. Wodehouse, London.
386. PADDLE-WHEELS, A. Dupassieux, London.
387. REAPING and MOWING MACHINES, C. Burnett, London.
388. WEIGHING MACHINES, T. Finney, Glasgow.
389. CANDLES, C. Wells, London.
390. TORPEDOES, C. Wells, London.
391. GAS GRILLER, S. de L. Phelps, London.
392. HOSE ELEVATOR, J. F. Jupp, London.
393. TORPEDOES, H. M. Bennett, London.
394. BOILERS for HEATING, &c., J. Stanley and I. Todd, London.
395. MAGAZINE or REPEATING RIFLES, &c., O. Jones, London.
396. ROLLED METAL ARTICLES, G. F. Simonds, London.
397. FILTRATION, H. Stockheim, London.
398. SUPPLYING LIQUIDS to ELECTRICAL BATTERIES, J. T. Armstrong, London.
399. MANUFACTURE of KERBS for PAVEMENTS, H. P. Flavelle, London.
400. WASTE WATER PREVENTER, W. H. Madge and J. B. Penrose, London.
401. PROPELLING BOATS by MANUAL POWER, J. Barrett, London.
402. FRICTION COUPLINGS, C. Little, London.
403. FURNACES, J. L. Sampson and J. Hart, London.
404. FEEDING FUEL to FURNACES, J. L. Sampson and J. Hart, London.
405. LOCK, H. C. Böhringer, London.
406. REGENERATIVE FURNACES, H. C. S. Dyer, London.
407. FLUSHING CISTERNS, G. and S. Jennings, and J. Morley, London.
408. BOTTLE WASHING, &c., MACHINES, H. R. Chubb, London.
409. STREET CURB for RECEIVING ELECTRIC WIRES, W. Reddall, London.

11th January, 1886.

410. SELF-COUPLING APPARATUS for RAILWAY CARRIAGES, &c., C. Clements, London.
411. HAND PLANING, &c., MACHINE, B. Sutcliffe, Halifax.
412. FLEXIBLE CONNECTIONS of STEAM PRESSES, F. Craven and B. Sutcliffe, London.
413. REGULATING, &c., the SUPPLY of AIR to TENTERING MACHINES, F. Craven, Halifax.
414. TRAVERSING the HACKLES, &c., of CLOTH TENTERING or DRYING MACHINES, F. Craven, Halifax.
415. COTTON FIGURED WEFT PILE FABRICS, J. Edelston, Manchester.
416. STOPPERS for BOTTLES, &c., D. Rylands, Barnsley.
417. HEATING CARRIAGE for BILLIARD, &c., TABLES, J. Tufnail, Reading.
418. CORSET SUPPORT and FEMALE FIGURE IMPROVER, G. Webb, Brighton.
419. POTATO DIGGING, C. R. Sephton, Edinburgh.
420. CANDLE and NIGHT LIGHT SELF-ADAPTING SAFETY HOLDER, C. G. Knight, Southsea.
421. CLEANING CARPETS, &c., E. Davis, Caversham.
422. SLEEVE LINKS, G. P. Bolger, Kingstown.
423. RAIL CHAIR, W. Hind, Cumberland.
424. SPINDLES of POLISHING LATHES, W. A. Carlyle, Birmingham.
425. BRUSHING HAIR, &c., S. R. Bolger, Dublin.
426 BOXING GLOVES, B. Birnbaum, London.
427. HEATING ROOMS, C. Weygang, London.
428. MECHANICAL MUSICAL INSTRUMENTS, H. F. Hambruch, London.
429. SMOKING PIPES, J. Murray, London.
430. EXPOSING PHOTOGRAPHS, D. S. Davis, London.
431. TWIST LACE NET, J. Drummond, London.
432. PREVENTING the OVERFLOW of SINKS, A. C. Henderson.—(*R. Délogé, France.*)
433. SILK-LIKE YARNS, &c., W. Fairweather.—(*S. J. A. Laing, United States.*)
434. TINNING PLATES, &c., A. J. Maskrey and W. Jones, Glasgow.
435. LEGGINGS, C. Malings, London.
436. CUTTING ROLLERS, J. Brierley, Halifax.
437. GENERATING STEAM, H. G. Huntington, London.
438. FUSTIAN CUTTING FRAMES, A. V. Sharratt, London.
439. BRACES, &c., J. Watson, London.
440. CHIMNEY TOPS, S. Jenner, London.
441. OPENING and CLOSING WINDOWS, &c., J. Pullar, London.
442. DRIVING MECHANISM for VELOCIPEDES, S. Davies, London.
443. METALLIC RIMS of the WHEELS of VELOCIPEDES, B. Wareing, London.
444. LIQUID METERS, W. G. Stuart, London.
445. HYDROCARBON SAFETY LAMPS, S. Siemang and A. Breden, London.
446. CASKS, C. Hewitt and W. W. Hewitt, London.
447. PORTLAND CEMENT, H. Peters, London.
448. BOTTLING APPARATUS, N. G. Wilcocks and N. St. G Wilcocks, London.
449. TREATMENT of OILS, J. Y. Johnson.—(*C. L. Baillard, France.*)
450. ELECTRIC LAMPS, B. J. B. Mills.—(*A. Million, France.*)

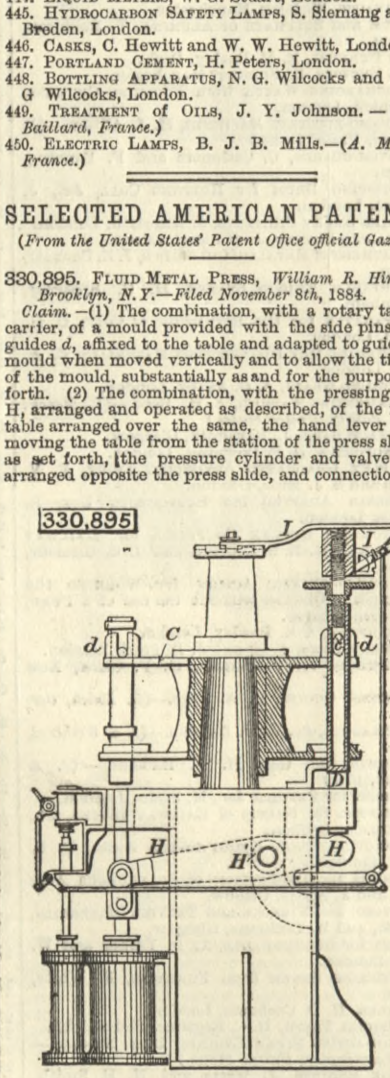
SELECTED AMERICAN PATENTS.

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

330,895. FLUID METAL PRESS, *William R. Hinsdale, Brooklyn, N.Y.—Filed November 8th*, 1884.

Claim.—(1) The combination, with a rotary table or carrier, of a mould provided with the side pins *c* and guides *d*, affixed to the table and adapted to guide the mould when moved vertically and to allow the tipping of the mould, substantially as and for the purpose set forth. (2) The combination, with the pressing lever H, arranged and operated as described, of the rotary table arranged over the same, the hand lever I, for moving the table from the station of the press slide D, as set forth, the pressure cylinder and valve chest arranged opposite the press slide, and connections for

330,895

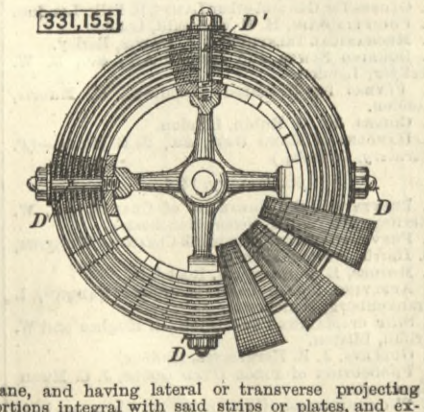


moving the valve from the station of the hand lever I, as and for the purpose set forth. (3) In an ingot press provided with a rotary table, the combination, with the table and its central supporting pillar, of the bed provided with the pivotted lever H, and having the press slide D arranged at one end of such lever, and a pressure cylinder arranged at the other end of such lever and connected thereto, the whole operated substantially as and for the purpose set forth.

331,155. ARMATURE FOR DYNAMO-ELECTRIC MACHINES AND MOTORS, *Benjamin F. Orton, East Saginaw, Mich.—Filed June 13th*, 1884.

Claim.—(1) An armature built up from thin superposed sheet iron strips or plates bent in the armature

331,155

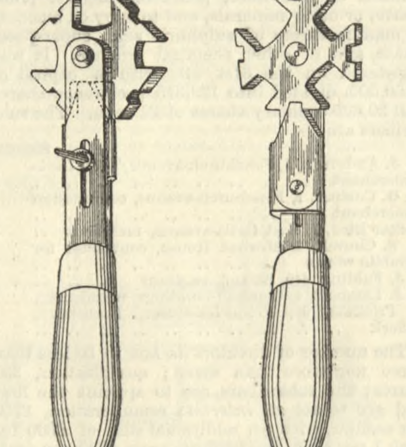


plane, and having lateral or transverse projecting portions integral with said strips or plates, and extending parallel with the axis of the armature, the superposed projecting portions being separated from one another by free air spaces. (2) In a dynamo-electric machine or motor, a ring armature having lateral projections at the spaces between the armature coils, said projections being composed of thin sheet iron plates placed one above the other in a radial line extending from the armature centre, and separated from one another by air spaces in planes transverse to such radial lines. (3) The combination with a radial pin or bolt, as D, of two or more perforated sheet metal strips having slots, as at H^1, for a radial pin or bolt, as D^1. (4) In an armature for a dynamo-electric machine or motor, the combination with two or more superimposed sheet-metal strips, each having lateral extensions, and bent in the armature plane of rotation, of interposed separating pieces of iron. (5) In an armature made from iron in thin strips bent to the form of the armature, and having air spaces extending laterally between the layers, lateral extensions integral with the bent strips.

331,158. WRENCH, *Edward Phillips, Cleveland, Ohio.—Filed September 15th*, 1885.

Claim.—(1) In a wrench, the combination, with a head pivotted to the outside of the shank or handle of the wrench, said head having a series of notches on the periphery adapted, respectively, to engage nuts, of a dog attached to the handle, for engaging the said notches on the periphery of the head to hold the head in the desired position, substantially as set forth. (2)

331,158

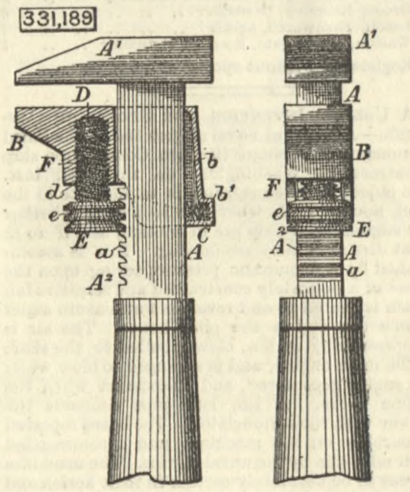


In a wrench, the combination, with a revolving head pivotted to the handle, said head having a series of graduated notches on the periphery thereof, of a sliding dog arranged upon the handle to engage the respective notches on the periphery of the head, a thumb-screw for fastening the dog, substantially as set forth.

331,189. RAPID TRANSIT WRENCH, *James Du Shane, South Bend, Ind.—Filed July 15th*, 1885.

Claim.—The combination, in a rapid transit wrench, of the shank A, having the fixed jaw A^1 secured to its end, and the rack A^2 formed on its front edge with teeth of said rack at right angles across its said edge, the travelling jaw B, provided with the chamber *b* and spring recess b^1, immediately in rear of the shank slot, and with the threaded recess D in front of said slot, the

331,189

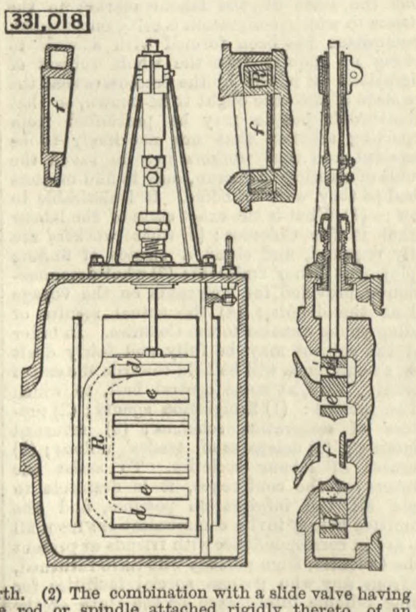


tooth or flanged button E, engaging with the teeth of the shank but not travelling on the shank thereby, the threaded stem F, having its lower end fixed centrally on the button E, and the coiled spring C in the recess *b* and acting against the back of the shank, all substantially as specified.

331,018. BALANCED SLIDE VALVE, *Daniel A. Woodbury, Rochester, N.Y.—Filed April 8th*, 1885.

Claim.—(1) In a slide valve working under a relief plate, the combination of the exhaust cavity *f*, passage or passages *e*, passages *d* and d^1, and passage or passages R, all arranged and operating substantially as set

331,018

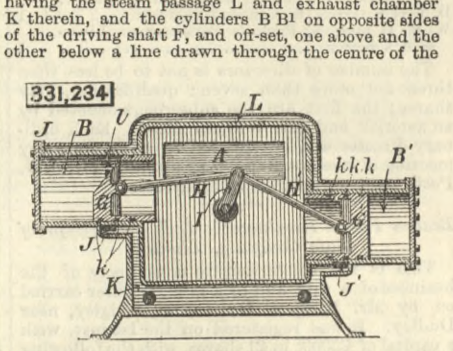


forth. (2) The combination with a slide valve having the rod or spindle attached rigidly thereto, of an adjustable bracket provided with suitable guide-box or guide, and a stuffing-box, constructed and operating substantially as shown and described. (3) The combination with an adjusting wedge and adjusting screw of the nut *m*, located inside of the chest, substantially as and for the purposes specified.

331,234. STEAM ENGINE, *Dexter D. Hardy, Chicago, Ill.—Filed March 27th*, 1885.

Claim.—(1) In a steam engine, two single-acting cylinders placed equidistant from each other around a central driving shaft, each of said cylinders being offset at about one-half of the radius of the crank to one side of a line drawn through the centre of the main shaft and parallel with said cylinder, said cylinders having in connection therewith suitable steam chests, steam ports, and valves, with suitable mechanism for operating the same, and each cylinder having a single-acting piston connected by separate connecting-rods to the same crank on the driving shaft in the manner substantially as and for the uses and purposes specified. (2) In a steam engine having two or more single-acting cylinders placed around a central driving shaft and off-set to one side of a line drawn through the centre of the driving shaft and parallel to said cylinders, respectively, the combination of the pistons G G^1, the connecting rods H H^1, and the crank I on the driving shaft F, working in bearings $m\ m^1$, in the manner and for the purposes specified. (3) In a steam engine, the engine frame A, having the steam passage L and exhaust chamber K therein, and the cylinders B B^1 on opposite sides of the driving shaft F, and off-set, one above and the other below a line drawn through the centre of the

331,234

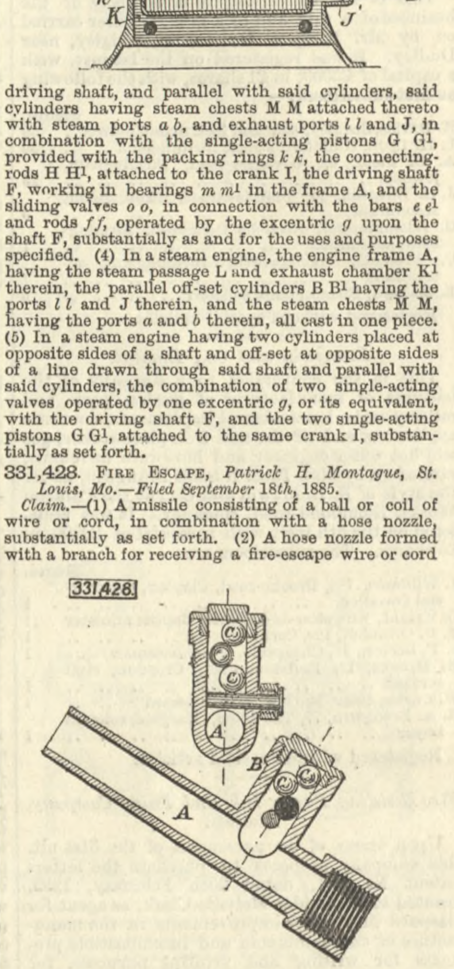


driving shaft, and parallel with said cylinders, said cylinders having steam chests M M attached thereto with steam ports *a b*, and exhaust ports *l l* and J, in combination with the single-acting pistons G G^1, provided with the packing rings *k k*, the connecting-rods H H^1, attached to the crank I, the driving shaft F, working in bearings $m\ m^1$ in the frame A, and the sliding valves *o o*, in connection with the bars $e\ e^1$ and rods *f f*, operated by the excentric *g* upon the shaft F, substantially as and for the uses and purposes specified. (4) In a steam engine, the engine frame A, having the steam passage L and exhaust chamber K^1 therein, the parallel off-set cylinders B B^1 having the ports *l l* and J therein, and the steam chests M M, having the ports *a* and *b* therein, all cast in one piece. (5) In a steam engine having two cylinders placed at opposite sides of a shaft and off-set at opposite sides of a line drawn through said shaft and parallel with said cylinders, the combination of two single-acting valves operated by one excentric *g*, or its equivalent, with the driving shaft F, and the two single-acting pistons G G^1, attached to the same crank I, substantially as set forth.

331,428. FIRE ESCAPE, *Patrick H. Montague, St. Louis, Mo.—Filed September 18th*, 1885.

Claim.—(1) A missile consisting of a ball or coil of wire or cord, in combination with a hose nozzle, substantially as set forth. (2) A hose nozzle formed with a branch for receiving a fire-escape wire or cord

331,428

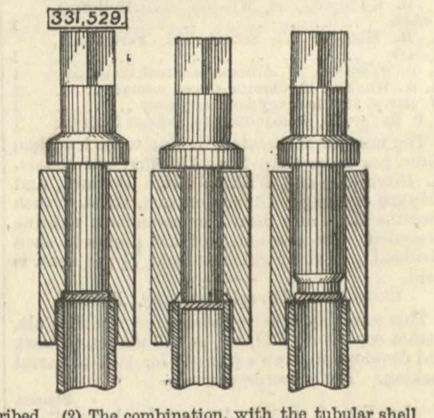


and having a cross pin, substantially as set forth. (3) A ball of wire or cord, in combination with a hose nozzle having a branch in which the ball is placed, substantially as set forth.

331,529. APPARATUS FOR CENTREING AND INSERTING DISCS IN THE ENDS OF TUBES, *Carleton W. Nason, New York, N.Y.—Filed October 9th*, 1885.

Claim.—(1) The herein-described device for centreing discs over the ends of tubes, consisting of the tubular shell C, provided upon its interior with the curved or inclined shoulder *c*, substantially as de-

331,529



scribed. (2) The combination, with the tubular shell C, provided upon its interior with the curved or inclined shoulder *c*, of the plunger or rammer B, substantially as described. (3) The combination, with the tubular shell C, provided upon its interior with the curved or inclined shoulder *c*, of the plunger or rammer B, having the collar *b*, substantially as described.