EXAMPLES OF THE GRAPHIC TREATMENT OF STRESSES IN FRAMEWORK.

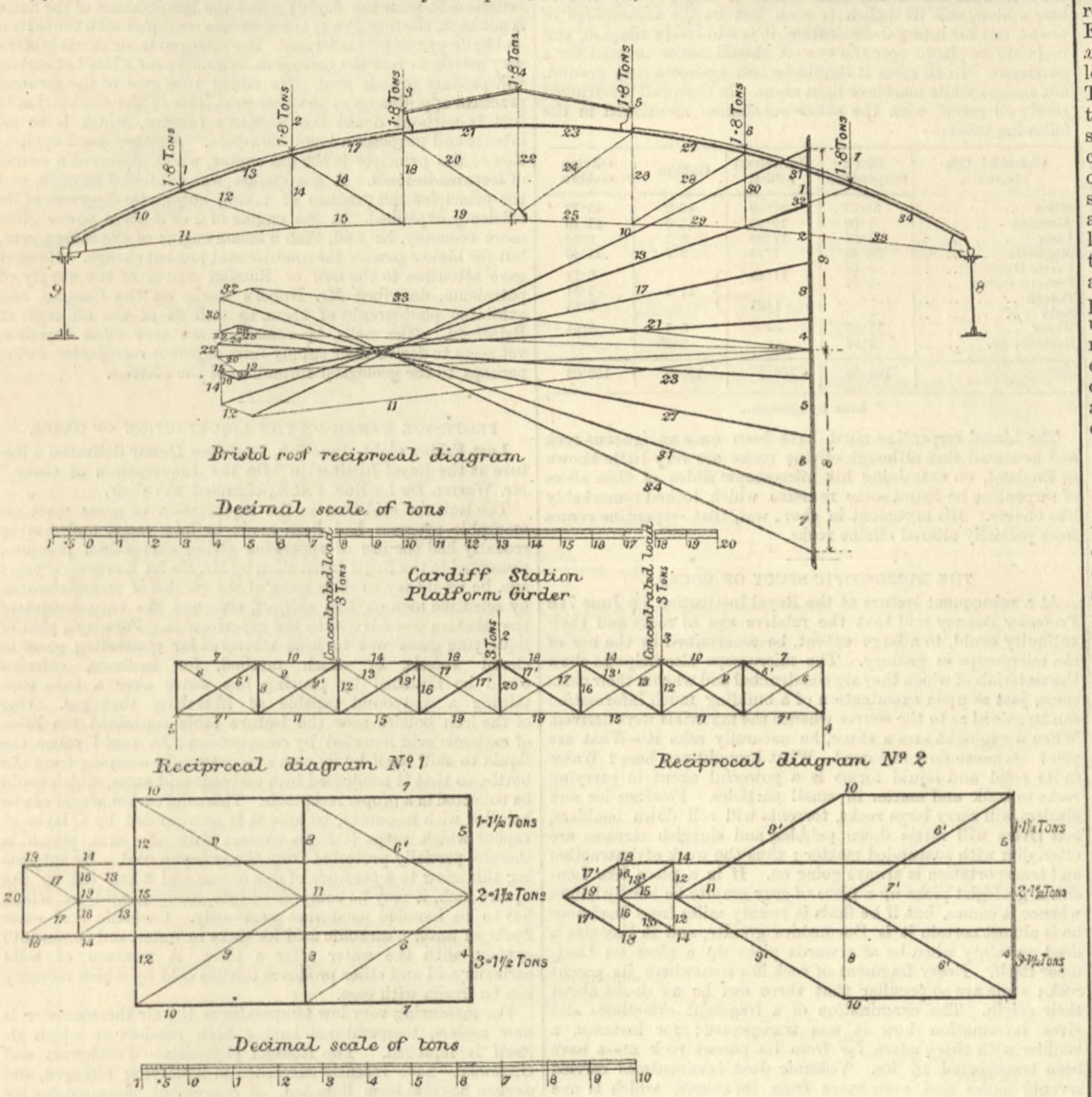
By ROBERT HUDSON GRAHAM, C.E.

No. V.

1. *Goods shed roof, Bristol.*—The roof over Bristol goods shed, represented in outline below, is 56ft. in span and 9ft. 9in. in total rise, so that the ratio of rise to span, expressed in fractional form, is $\frac{1}{5{\cdot}74}$. The principals are 13ft. 6in. apart. The incumbent weight upon the roof is found by assuming 45 lb. to be superposed upon each square foot of covering between bays. This includes dead weight of material as well as all accidental weights arising from wind pressures and lodgment of rain and snow. Subsequently to the publication of my treatment of the Didcot roof—vol. lvi., p. 136—an anonymous correspondent, in a letter to THE ENGINEER, found fault with the method just expounded of dealing with wind pressures on roofs. The writer of the letter argued that if the total load were taken at 56 instead of 45 lb. per square foot, and the wind were supposed to blow only on one side of the roof, the stresses would be found to change both in "nature and amount." He did not, however, proceed to substantiate these statements by a reciprocal diagram constructed according to these conditions. As a matter of fact, the effect of wind, when supposed to blow only on one side of a roof, is rather to compensate than to alter the stresses due to vertical loads. This arises from the circumstance that the direction of wind pressure is nearly at right angles to the direction of dead weight or gravity. If, as some suppose, the wind blows in a perfectly horizontal line, then the directions of gravity and wind pressure are strictly at right angles. Owing to this fact, partial loading does not necessarily imply the most unfavourable condition of load. Strictly and theoretically speaking, we ought to load a roof separately right and left for wind pressure, and select that combination of wind and vertical load which represents and produces the most unfavourable condition of stress in any particular bar. But I hold that this process—which is absolutely necessary in the case of bridges—is uncalled for in the case of roofs, and that it is perfectly legitimate to include the accessory pressures due to wind in the form of increments of the vertical loads. Following this principle, I resolve wind pressures, impinging at a given angle, in two directions, one vertical, the other parallel, to the side rafter of the roof. But I have neither object nor intention to decide a question of this nature upon my own reasoning or authority. Therefore, since the publication of my last article, I have looked up several authors of good repute, in order, if possible, to find which way the balance of scientific opinion inclined. The outcome of this research was the simple discovery that, as a rule, our older technical writers avoid expressing any opinion at all upon the subject. Apparently, wind pressures did not form part or parcel of their philosophy. As far as I am aware, the only author who ventures to deal with the problem is M. Maurice Levy, who entirely confirms, or rather anticipates me in treating wind pressures on roofs as part of the vertical load. He says:—"Cette force (du vent) doit être composée avec les forces verticales résultant du poids de la toiture et avec la charge verticale produite par la neige." Wherefore, according to M. Levy, wind pressures ought to be compounded with the vertical loads arising from the dead-weight of the roof and the superincumbent weight of snow. This is one of those cases where practice, for the sake of convenience and economy of time, abandons theory and neglects the small, infinitesimal errors which may arise from considering the roof uniformly, and not partially loaded with wind pressures. The errors involved are in most cases extremely small, and generally lie upon the safe side. I also find that in the case of a roof, the rise of which bears to its span a proportion of 1 to 4, M. Levy assumes a total load, composed of dead-weight of iron covering, wind, and snow, equivalent to 140 kilogs. per square metre, or in British measures, to 28 lb. per square foot. For a slate covering he increases the total load to 165 kilogs. per square metre, or 33 lb. per square foot. It will be seen that these amounts lie considerably below the load of 56 lb. recommended by our anonymous critic, and are, in fact, much lower than the limit of 45 lb., which we adopted for the Didcot roof. The reciprocal diagram, Fig. 2, of the Bristol roof shows that the maxima stresses occur, not as usual in the extreme divisions 10 and 34 of the side rafters, but, owing to the arched form of the roof, in the divisions 13 and 31, in each of which the stress amounts to 19·5 tons. The thrust in the arched rib decreases uniformly from these divisions towards the ridge or crown. The stresses in the inclined members of the bracing alternate in nature, bars 12 and 20 being in tension, and bar 16 in compression. This alternation is due to the curved form of the roof. If, as in the Didcot and Weymouth examples, the side rafters were perfectly straight, and the roof section triangular, the stresses in bars 12, 16, and 20 would be all compressive. One good effect of these changes in the nature of the diagonal stresses is the consequent diminution of strain in the central tie rod 22, which is reduced in this instance to 0·3 of a ton. I am unaware how far, if at all, the designers of the roof had this object in view. In any case, the reduction presents a very pleasing feature, and tends to convince us of the decided suitability of this form for station buildings. By way of comparison, it may be mentioned that the stress in the central tie of the Didcot roof amounts to as much as 9 tons, and in fact, generally speaking, the stresses in the central tie-rods of all triangular roof trusses have a tendency to be large, whilst the stresses all round in the cross bracing are relatively greater than in curved frames of the kind exemplified in the Bristol roof.

2. *Cardiff platform girder.*—The span of this small lattice girder is 40ft. It supports at joints 1, 2, 3, concentrated loads, each equal to 3 tons. The reciprocal figure shows that, as usually occurs in this type of girder, the top boom is in compression and the lower boom in tension. The verticals under load are all struts, and the diagonals alternately struts and ties. This girder is obviously a combined lattice form, and can therefore be decomposed into its component frames, the reciprocals of which are given in diagrams Nos. 1 and 2. The stresses are in every instance cumulative, which means that the stress in any bar is the graphic sum of the component stresses arising from the frames of which it forms a constituent part. Thus the tension in bar 19 is given by the sum:—Line 19 (diagram No. 1) + line 19 (diagram No. 2). The diagonals, taken separately, form part of only one of the two frames, and therefore the inclined stresses are derived independently from one or other of the two reciprocal figures.

Before closing this series of examples of the graphic treatment of stresses in frameworks, I may mention that they form the solutions of a series of problems set in one part of my work on "Graphic and Analytic Statics," recently published. I found it anything but an easy task to find a concise and convenient form in which to set an example and give an answer to a problem in graphic statics. The method I ultimately hit upon is very simple, and on that account will, I trust, meet with the sanction and approval of practical mathematicians. In order to show how a problem of this kind may be enunciated and its solution put in an abbreviated, but nevertheless adequate, form, I will take the Bristol roof as an illustration. The skeleton outline of this structure is given on a plate which opens clear of the page, so that the student may easily make a tracing of it. This outline is drawn in thin or unshaded lines, which convey no idea of the nature of the stresses. Certain bars, such as 15, 16, and 17, are then chosen and marked with the symbols x, y, and z. In the text the example is set, and the answer given thus:—"Construct the reciprocal diagram of the roof structure—Bristol goods shed, Fig. 173, Plate 1—and find the stresses produced in bars x, y, z—17, 16, and 15 respectively—by the given applied loads." $x = +\ 18{\cdot}5$ tons; $y = +\ \frac{1}{2}$ ton; $z = -\ 18{\cdot}6$ tons. The plus sign signifies compressive and the minus sign tensional stress. This method of setting an example possesses several advantages. First, it gives the student no clue to the answer, and imposes upon him the obligation of solving the problem solely by the aid of first principles; secondly, the bars marked by symbols can be selected, so as to necessitate the construction of the entire, or, at least, of the most difficult part of the reciprocal figure; thirdly, the answers form a sufficient check upon the accuracy of the class-work, at the same time relieving the professor of the duty of constructing the figure for himself, unless he sees reason to suspect error in some of the results. At present I am not aware of any errors having crept into any of the answers; but I take this opportunity of stating that I shall be glad to receive information of any faults which it is possible may have escaped my own observation.



THE THEORY OF TURBINES.

WE publish this week a letter by Mr. Donaldson, which shows that some misapprehension exists which ought to be cleared up. What we mean by "sudden" change of curvature, is instantaneous change of curvature; such, for instance, as would occur if the path were formed of two circular arcs joined on to each other tangentially, but of different radii. The change of curvature may be as rapid as desired, so long as the radius of curvature in changing goes through all values, or grades, intermediate between its first and last values. That is what is meant by "gradual" change. There is no reason for making the minimum radius as large as possible; quite the reverse. The "absolute" path should not be straight, but curved as sharply as it conveniently can be. We cannot agree that there is any impropriety in the ordinary meaning given to the phrase "modulus of elasticity," but we are aware that the modulus is not necessarily the same for large compressive as for large tensile stresses. This, however, has nothing to do with the theory of turbines. We may have to comment on the theory of beams on another occasion, and explain the deficiencies of the ordinary theory. In doing so we shall be glad to notice Mr. Donaldson's book on beams if he will send it to us.

Regarding the formulæ given in our article, it should be remembered that what is in books called the water's "absolute" velocity is its velocity taken relatively to the earth. It is only another "relative" velocity. What is commonly called its "relative" velocity is its velocity taken relatively to the blades of the rotating wheel, *i.e.*, the velocity it would have relatively to the earth if it flowed through the wheel, the wheel being motionless relatively to the earth. We gave the formulæ for the pressure, and the work done in terms of the velocity relative to the wheel. The centrifugal force of the water calculated from its absolute motion is certainly not the same as its centrifugal force calculated from its relative motion. But the difference is exactly made up by the extra inertia resistance to increase of linear—*i.e.* non-deviating—momentum that is experienced in the absolute motion, and not in the relative motion. This is true, at any rate, if the blade be supposed to move—relatively to the earth—with a uniform non-deviating velocity in a straight line. It was on this supposition—as stated in our last article—that the equations we gave were deduced. As this is a somewhat interesting point over which many students fall into almost hopeless confusion of mind, we give here as simple an algebraic proof of the fact as occurs to us at the moment. We give below a very simple geometrical proof of the more general proposition for the resultant of any two motions, whether these be either or both variable or constant in direction and magnitude; which general case, of course, includes this more simple one as a special case.

Let V be the uniform rectilinear velocity of the blade. Let v be the relative velocity of the water over the blade, and let at any instant the direction of v make the angle θ with that of V. Let this relative velocity be constant in magnitude and have its direction deviating at a uniform rate ϖ. Thus the relative velocity is supposed to be a uniform circular motion. If r be its radius of curvature, the centripetal acceleration of velocity is $\frac{v^2}{r}$, and this may be conveniently written in the other form $v\varpi$. Also $\frac{d\theta}{dt} = \varpi$.

Resolve the relative velocity v into two components; one parallel to V, and equal to v cos. θ; the other perpendicular to V, and equal to v sin. θ. The absolute velocity may be looked on as being composed of two components in the same directions, namely, one parallel to V and equal to $V + v \cos. \theta$; the other perpendicular to V and equal to $v \sin. \theta$. The whole magnitude of the "absolute" velocity is, therefore,

$$\sqrt{(V + v \cos. \theta)^2 + v^2 \sin.^2 \theta} = \sqrt{V^2 + 2 V v \cos. \theta + v^2}.$$

The linear, non-deviating (or tangential) acceleration of this absolute velocity is

$$\frac{d\theta}{dt} \cdot \frac{d\sqrt{V^2 + 2 V v \cos. \theta + v^2}}{d\theta} = -v\,\omega \frac{V \sin. \theta}{\sqrt{V^2 + 2 V v \cos. \theta + v^2}}$$

The direction of this absolute velocity is best defined by the tangent of the angle of its inclination to V. The angle is evidently $\tan.^{-1} . \dfrac{v \sin. \theta}{V + v \cos. \theta}$.

The rate at which this angle increases is the rate of deviation or the angular velocity in the absolute path. This angular velocity is thus got by differentiation. It equals

$$\frac{d\theta}{dt} \cdot \frac{d}{d\theta}\left\{\tan.^{-1} \frac{v \sin. \theta}{V + v \cos. \theta}\right\} = \frac{\varpi v}{1 + \dfrac{v^2 \sin.^2 \theta}{(V + v \cos. \theta)^2}}$$

$$\times \frac{\cos. \theta (V + v \cos. \theta) + v \sin.^2 \theta}{(V + v \cos. \theta)^2} = \varpi v \frac{V \cos. \theta + v}{V^2 + 2 V v \cos. \theta + v^2}$$

The centripetal acceleration in the absolute motion is this angular velocity multiplied by the absolute velocity; or—

$$\varpi v \frac{V \cos. \theta + v}{V^2 + 2 V v \cos. \theta + v^2} \sqrt{V^2 + 2 V v \cos. \theta + v^2}$$

$$= \varpi v \frac{V \cos. \theta + v}{\sqrt{V^2 + 2 V v \cos. \theta + v^2}}$$

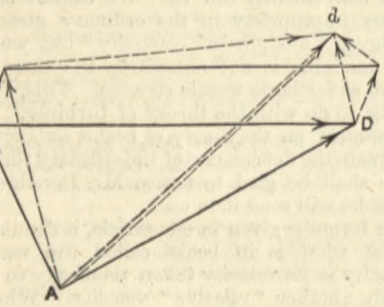
Now the whole acceleration in the absolute motion equals the square root of the sum of the squares of its two rectangular components; namely, the centripetal and the tangential or non-deviating components. This is—

$$\varpi v \frac{\sqrt{V^2 \sin.^2 \theta + (V \cos. \theta + v)^2}}{\sqrt{V^2 + 2 V v \cos. \theta + v^2}}$$

$$= \varpi v \frac{\sqrt{V^2 + 2 V v \cos. \theta + v^2}}{\sqrt{V^2 + 2 V v \cos. \theta + v^2}} = \varpi v$$

That is, the whole acceleration in the absolute path is the same exactly as that in the relative path. It must be remembered, however, that this proposition is only proved to be true on the assumption that V, the velocity of the blade, is uniform and rectilinear. This is not accurately true for the case of a turbine, for each point or *each small part* of the length of the passage through the blades of the turbine we have different magnitudes and directions for V.

The corresponding more general proposition which enables us to take into account the curvature of the path of the blade and the difference of its linear velocity at different points of its length is this, namely, that in any motion, which is the resultant of two component motions, the acceleration of velocity is the resultant of the two accelerations of velocity of the two component motions. The acceleration in either or both of the component motions may be partly radial—*i.e.*, normal—and partly tangential. This proposition appears almost self-evident when it is considered with the help of the annexed diagram.



Let A B represent one of the component velocities at a certain instant, and at the same instant let the other component velocity be represented by BD. The resultant velocity in the compound motion is at this instant A D. At the end of a second let the first component have changed so that its direction and magnitude are now represented by A b, and during the same interval of one second let the second component have changed so that its direction and magnitude are now represented by b d. The resultant velocity is now represented by A d. During this second the *change*—or acceleration per second—of the first component is B b, because A b is the resultant of A B and B b. Draw b D' equal and parallel to B D so that b D' represents—in the same way as B D does—the first value of the second component. Then since D D' is equal and parallel to B b, it —D D'—also represents the acceleration of the first component. In the same way D' d is the acceleration of the second component, because this second component has changed from b D' to b d. Also the resultant velocity has changed from A D to A d. Therefore, D d is the acceleration of the resultant velocity. But D d is the resultant of D D' and D' d. That is, the acceleration of the resultant velocity is the resultant of the two accelerations of the two component velocities.

The application of this perfectly general proposition to turbines is easily recognised. The acceleration of momentum of the water investigated in our last article, due to its relative motion over the blades, is to be compounded with the acceleration due to its circular motion along with the blades round the rotating shaft. As we said before, of course this complicates the problem, and the formulæ are no longer so simple as those given in our last article. In reviewing some other books on turbines, which are lying on our shelf, we will return to this subject, but we may say just now that the most convenient method of dealing with it is to treat the two components separately as far as possible. In our last article we showed in their simplest form the working results of the more important of the two components of the whole motion.

Mr Donaldson will see that at the foot of the third column of our article we give the rate at which the water does work on the vane.

THE ROYAL INSTITUTION.

ROCK SERPENTINE.

Professor J. G. Bonney, F.R.S., delivered a lecture at the Royal Institution on May 31st on "Rock Serpentine;" it was one of a course of lectures on the bearing of microscopical research upon some geological problems. He said that the word "serpentine" usually causes some confusion of ideas, for the name is given both to a mineral and to a rock, of which there are many varieties; it is a name very loosely used for various substances. The name is applied sometimes to a mineral having a soapy feeling in the hand, and used for making magnesia. As a rock it is more protean still. It has certain well-defined chemical and physical characteristics; it consists largely of silica and oxide of iron. He had obtained many specimens from the Lizard in Cornwall; they are of moderate weight, with compact ground-mass. The rock varies from green and black to a reddish colour; its hardness is about four in the geological scale; it is slightly unctuous to the hand, subconchoidal in fracture, and weathers rusty brown. Serpentine resembles deeply seated igneous rocks. There is much of it in Scotland, and some in Anglesea and Wales, as well as in many places on the Continent. Serpentine contains much water; either it is a precipitated rock, or of some kind of metamorphic origin. It can be worked freely, and sometimes can even be turned in the lathe. It has been employed in London in buildings, and there is some of it in the cathedral at Florence. Serpentine is rather too brittle for use in any place where it may possibly have to bear a blow, and its polish is soon lost in the atmosphere of towns, but for internal decoration it is admirably adapted, and it should be placed near the eye; it should never be used for a pavement. In all cases it should be laid against a dark ground, not against white marble or light stone. In Cornwall it is fringed nearly all round with the other substances mentioned in the following table:—

Chemical Constituents.	Black Serpentine.	Hornblend schist.	Gabbro.	Olivine Gabbro
Silica	38·50	47·40	49·0	45·73
Alumina	1·02	19·30	15·0	22·10
Lime	1·97	11·80	9·5	9·26
Magnesia	36·40	7·75	9·7	11·46
Ferric Oxide	4·66	11·40	11·5	0·71
Ferrous Oxide	3·31			3·51
Potash	—	1·05		0·34
Soda	—			
Water	12·35	—	0·3	2·54
Residue, &c.	2·37	—	2·5*	—
	100·58	100·0	100·0	100·03

* Loss by ignition.

The Lizard serpentine must have been once an igneous rock and he stated that although olivine rocks are very little known in England, on examining his microscopic slides of thin slices of serpentine he found some remains which looked remarkably like olivine. His argument in short was, that serpentine comes from partially altered olivine rocks.

THE MICROSCOPIC STUDY OF ROCKS.

At a subsequent lecture at the Royal Institution, on June 7th Professor Bonney said that the relative age of rocks and their antiquity could, to a large extent, be ascertained by the use of the microscope in geology. The microscope also helps to show the materials of which they are constructed and whence their parts come, just as upon examination of a building much information can be gained as to the source whence the materials were derived. When a geologist sees a stone, he naturally asks it—What are you? Whence do you come? What brought you here? Water in its solid and liquid forms is a powerful agent in carrying rocks in bulk and matter in small particles. Floating ice and glaciers will carry large rocks, torrents will roll down boulders, fast rivers will rattle down pebbles, and sluggish streams are often dim with suspended matter; thus the work of destruction and transportation is always going on. If in a place like London a geologist picks up a piece of grey granite he hardly knows whence it comes, but if he finds it twenty miles from Dartmoor he is almost certain it is Devonshire granite, and it becomes a dead certainty when he afterwards picks up a piece on Dartmoor itself. Every fragment of rock has somewhere its parent rock; some are so peculiar that there can be no doubt about their origin. The examination of a fragment sometimes also gives information how it was transported; for instance, a boulder with sharp edges far from its parent rock must have been transported by ice. Volcanic dust is sometimes carried seventy miles and even more from its source, which is one reason why the microscope is useful in the examination of fine grit and sand. Of trias there are three varieties, the Rhoetic, the Keuper, and the Bunter; the trias of Cheshire is more than a mile thick, and further south the beds grow thinner; they gradually fall off in a south-easterly direction, and come down into Devonshire, they also stretch to the east coast of England, altogether giving a configuration on the map of England somewhat resembling the letter "Y." He then adduced evidence that these beds were formed in prehistoric times by two great rivers, one flowing from the east and the other from the west of Scotland, and pointed out that the microscope had helped to trace the origin of these beds and their past history.

FLAME AND OXIDATION.

On Thursday, last week, in the course of his closing lecture on this subject, Professor Dewar stated in relation to the new melted platinum standard of light, that as platinum grows hotter, the relative proportions of red and green rays emitted by it vary, the following being the results obtained from some experimental researches of his own on the light radiation of the metal:—

Temperature.	Luminous intensity.	
Deg. Cent.	Red rays.	Green rays.
954	1·00	1·00
1045	3·27	3·64
1500	154·00	219·00
1775	507·00	809·00

He added that the object of the platinum standard is not, as erroneously supposed sometimes, that every man who indulges in photometrical experiments shall carry about a quantity of melted platinum with him, but that this more perfect standard shall be one with which the standard, but imperfect candles and lamps at present used in photometric work may be compared. The French Carcel lamp, he added, is decidedly a more perfect instrument for measuring luminous intensity than the English standard candle. The last temperature given in the foregoing table, 1775 Centigrade, is close upon the melting point of platinum, and in measuring the intensity of light, mean white light is chosen, not individual rays.

In one of his experiments Professor Dewar produced a small Bunsen flame at the end of a long platinum tube, and on heating a length of this tube, far from the flame, the flame became luminous; this, he remarked, might be said to be due to increased temperature, but the probability was that the effect was owing to the production of new compounds, because on testing the gases from the hot tube, acetylene was found to be among them. In this experiment the best test for acetylene, to make it generally visible to the observers, was not the ordinary copper test, but a solution of oxide of silver in ammonia; the product was the acetylide of silver, a white precipitate. Professor Dewar next exhibited an appliance for regulating the size of a gas flame; a glass bulb full of air was placed at a regulated distance above the flame, and the expansion of the air by heat was used to force mercury up the further end of a U-tube, where by other glass-blowing arrangements it exercised the functions of a tap, the rise or fall of the mercury increasing or decreasing the supply of gas to the burner. It could be so adjusted as to give a periodical jumping motion to a flame, and by other adjustment would cause it to burn with regularity. He next exhibited the purple flame of cyanogen, and as cyanogen contains no oxygen the flame was a pure carbon flame, which gives a magnificent and peculiar spectrum, due probably to a complicated molecule of carbon. Professor Dewar said that a trace of ammonia in any flame in which there is not complete combustion always enables the experimentalist to draw some prussic acid from the flame; when the temperature of the flame is not high, the nitrogen of the ammonia combines with the carbon and hydrocyanic acid is formed. The nitrogen in ammonia is often very active, in fact the passage of ammonia over white hot carbon will produce prussic acid. He added that one of the greatest practical applications of the true principles of the combustion of fuel is without doubt the Siemen's furnace, which is to all intents and purposes a huge blow-pipe. Another good application of the principle is the gas engine, which deserved a course of lectures in itself. A gas engine was exhibited at work, and the principles and practice of taking automatic diagrams of its efficiency explained. A gas engine of 2 or 3-horse power gives more economy, he said, than a steam engine of the same power, but for higher powers the conditions at present change. He next gave attention to the new or Russian source of the supply of petroleum, described Mr. Nobel's works on the Caspian, and exhibited photographs of them, as well as of the oil wells at Balachani. The wells, he remarked, are very close together, yet seem to derive their supply from separate receptacles, owing perhaps to the geological formation of the district.

PROFESSOR DEWAR ON THE LIQUEFACTION OF GASES.

Last Friday night, June 6th, Professor Dewar delivered a lecture at the Royal Institution "On the Liquefaction of Gases." Mr. Warren De La Rue, F.R.S., occupied the chair.

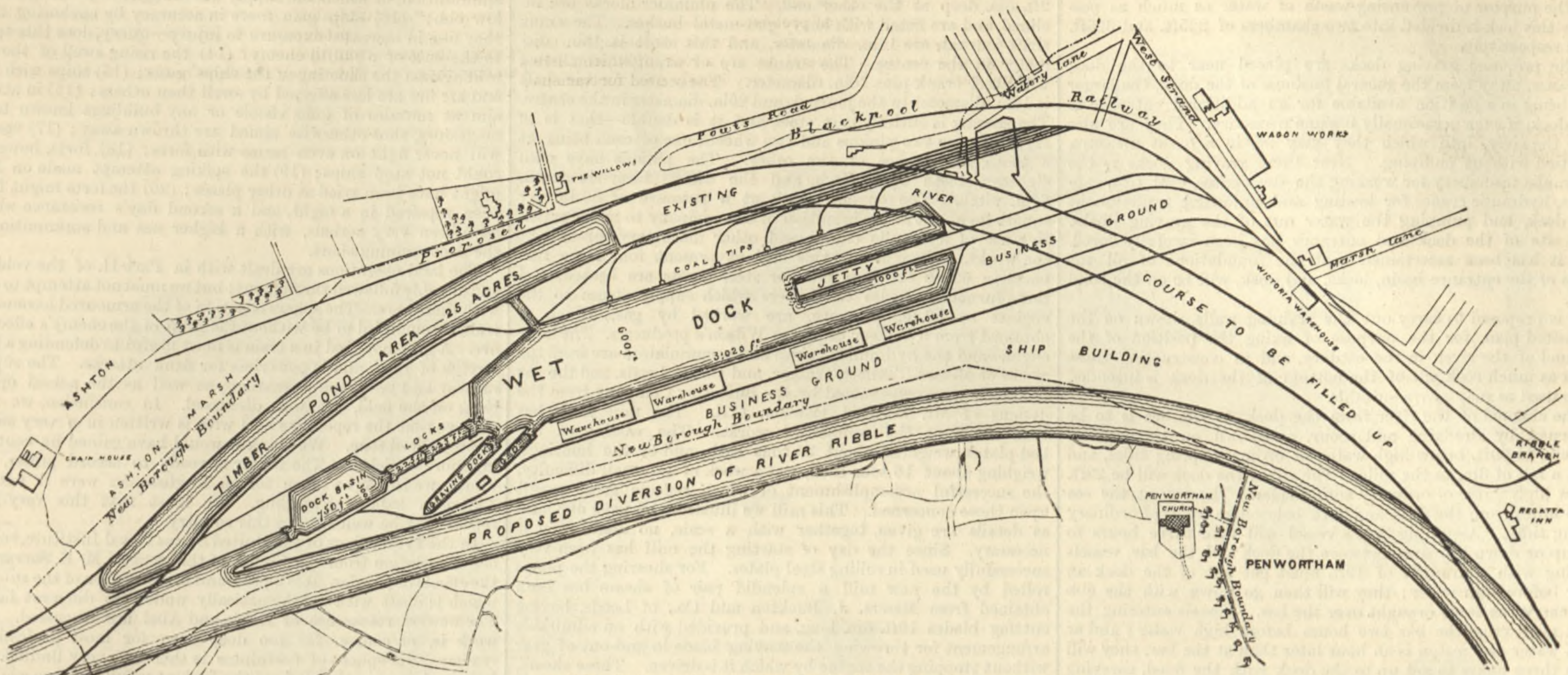
The lecturer said that in the liquefaction of gases most remarkable progress had been made in late years, and having recently had the use of apparatus giving exceptional pressure, presented to the Royal Institution by Mr. De La Rue several years ago, he would try to show some of the results of recent research by scientific men on this subject, although the temperature of the theatre was adverse to the experiments. Faraday's plan of liquefying gases was to heat mixtures for generating gases in closed vessels, by which method, for instance, chlorine could be liquefied by pouring hot water over a tube containing a compound capable of liberating that gas. One of the iron bottles near the lecture table contained ten litres of carbonic acid liquefied by compression; he could cause the liquid to chill itself by its own evaporation in escaping from the bottle, so that it condensed into carbonic acid snow, which could be collected in a proper receptacle. This solid carbonic acid can be handled with impunity, because it is surrounded by a layer of vapour which keeps it from contact with the skin, which is thereby partially protected from the extreme cold. By subjecting this snow to a pressure of one or one and a-half ton to the square inch, it may be compressed into carbonic acid ice, which has to be handled somewhat cautiously. Carbonic acid snow floats on water; carbonic acid ice sinks in water, and comes into contact with the water after a time. A mixture of solid carbonic acid and ether produces intense cold by which mercury can be frozen with ease.

For measuring very low temperatures the air thermometer is now useless, temperatures having been reached at which air itself is liquefied. Two Russian physicists—Wroblewski and Olszewski—have recently succeeded in liquefying nitrogen, and oxygen has been liquefied. A convenient thermometer for these low temperatures is therefore wanted; a simple and correct one for the purpose depends upon the production of thermo-electric currents; he therefore used long strips of iron and copper, soldered together at their points of junction, and when those points of junction at one end of the thermo pile were subjected to the action of low temperatures, whilst the points of junction at the other end of the pile were kept steadily at the temperature of melting ice, a method of indicating the very low temperatures given in the experiments was obtained. The current from this thermo-pile passed through the coils of a reflecting galvanometer, the mirror of which reflected a vertical line of light upon a cardboard scale extending all across the theatre; this scale extended from the boiling point of water to the absolute zero of temperature. On plunging one end of the thermo-pile in melting ice and the other in snow carbonic acid in ether, it was seen that the boiling point of carbonic acid was — 80 deg. C. The index remained steadily at that part of the scale. Professor Dewar then diminished the temperature by reducing the pressure of the air. When the ether and melting carbonic acid were subjected to the action of the air pump the temperature fell to — 110 deg. C., the lowest temperature which Faraday was able to gain with his appliances. About the lowest temperature obtainable by the use of solid carbonic acid is — 115 deg. C.

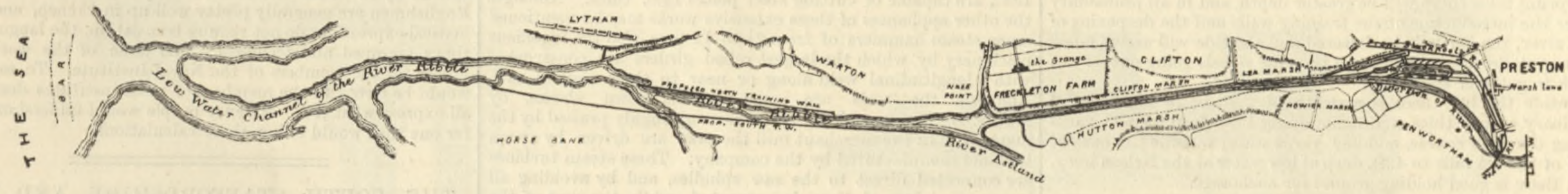
After the time of Faraday the greatest discoveries in relation to the liquefaction of gases have been made by Andrews, who discovered that every substance has a critical temperature, and he made an absolutely correct record of the pressures, temperatures, and volumes of gases. Professor Dewar then exhibited some liquid carbonic acid near its critical point, when just changing into gas; the tube, a magnified image of which was projected on the screen, seemed to be full of moving striæ. He next exhibited an allotropic form of oxygen, bisulphide of carbon at an extremely low temperature being charged with ozone, which dissolved in it without oxidising it, and formed a deep blue solution, which became colourless by evaporation of ozone. If the temperature rises sufficiently, combination takes place with explosive violence. Ozone is a blue-coloured gas, which can be condensed at very low temperatures, and is soluble in carbonic acid and bisulphide of carbon. Nitrous oxide is fluid at a little lower temperature than carbonic acid, and under the air pump it becomes solid; its

PRESTON DOCK AND RIBBLE IMPROVEMENTS.

MR. EDWARD GARLICK, C.E., ENGINEER.

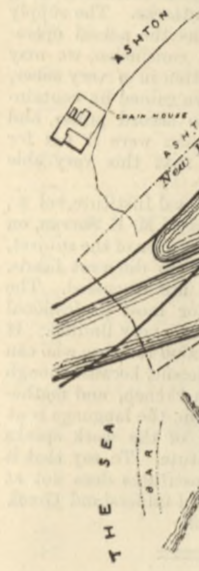


SKETCH PLAN SHOWING THE RIVER FROM PRESTON TO THE SEA



boiling point is − 100 C. A most useful substance for producing low temperatures is liquid ethylene, which had never been previously used in any quantity at the Royal Institution, but on the occasion now under notice, Professor Dewar had about 5 lb. weight of it, at a pressure of about 100 atmospheres, made during a fortnight, and contained in an iron bottle surrounded by ice and salt, for it will not remain liquid above 10 deg. C. Ethylene is one of the chief illuminating constituents of coal gas; it can be condensed into a transparent liquid within certain ranges of temperature. The liquid boils at a lower temperature than carbonic acid, and in vacuo it gives a temperature lower than any ever before produced in the presence of a Royal Institution auditory.

Professor Dewar then permitted a few ounces of liquid ethylene to flow from its bottle, through a brass tube 7in. or 8in. long, kept in a mixture of solid carbonic acid and ether, after which it was passed into the vessel K H, represented in the accompanying diagram, in which A B is a closed rectangular vessel with glass sides, kept dry inside by phosphoric anhydride at D. An india-rubber cork at N carries the tube E F with its flattened bulb, containing the substance to be frozen. P is connected with the air pump to quicken the evaporation of the ethylene. With this arrangement the lecturer froze absolute alcohol, and as it melted it flowed along the tube in a slow oily manner, exactly like glycerine. He also froze ether, bisulphide of carbon, and he liquefied oxygen. The chief difficulties of the lecture were, he said, in the projection of the experiments on the screeen, so that all present could see what was taking place. The india-rubber connections also gave trouble; they were frozen as hard as board, and lost all pliability. The evaporating ethylene gave a temperature of − 125 deg. C., and when the air pump was applied it fell to − 145 deg. or − 150 deg. C. By the use of liquid oxygen two Russian chemists have reached the temperature of − 200 deg. C., the lowest temperature yet obtained by man. Oxygen boils at about 185 deg. C. Hydrogen has been condensed into a colourless fluid, mobile, transparent, and with no appearance of metallic reflection; its boiling point has not yet been determined, but it is probably somewhere about — 200 deg. C. Fluid oxygen has a low refractive index. He saw great probability of these new advances in science being utilised for practical purposes; there was no reason why solid carbonic acid should not be used for putting out fires and other purposes, and it is at present employed in certain instances in steel making, for in water it will get up enormous pressure very quickly. These powers may of course be used for evil as well as good purposes; for a safeguard it is necessary to look to the growth of the moral side of the nature of man.



The listeners were so interested in this lecture that many of them remained for an hour after it was over to see more experiments. In the course of the evening Professor Dewar called attention to the following figures and formulæ :—

Critical Temperatures and Pressures.

		Critical temperature T.	Critical pressure P.	T/P
		deg.		
Marsh gas	CH_4	− 99·5	50·0	3·2
Acetylene	C_2H_2	− 37·0	68·0	4·5
Ethylene	C_2H_4	− 10·1	51·0	5·5
Ethylhydride	C_2H_6	− 35·0	45·2	6·8
Amylene	C_5H_{10}	− 191·6	33·9	13·7
Benzol	C_6H_6	− 291·7	60·4	9·3
Chloroform	$CHCl_3$	− 268·0	54·9	9·6
Carbon chloride	CCl_4	− 282·0	57·6	9·6
Carbonic acid	CO_2	− 31·9	77·0	4·0
Bisulphide of carbon ..	CS_2	− 277·7	78·1	7·0
Cyanogen	C_2N_2	− 124·0	61·7	6·4
		deg.		
Chlorine	Cl	− 141·0	83·9	5·0
Hydrochloric acid ..	H_2Cl	− 52·2	86·0	3·7
Oxygen	O_2	− 113·0	50·0	3·2
Water	H_2O	− 370·0	195·5	3·5
Hydrogen sulphide ..	H_2S	− 100·2	92·0	4·0
Ammonia	H_3N	− 130·0	115·0	3·5
Diethylamine	$(C_2H_5)_2N$	− 220·0	38·7	12·7
Nitrous oxide	N_2O	− 35·4	75·0	4·1
Sulphurous acid	SO_2	− 155·4	78·9	5·4

Ranges of Physical Conditions.

	Point of fusion.	Range of liquid.	Range of solid.
	deg.	deg.	deg.
Water	0	370	273
Cyanogen	− 34	158	239
Carbonic acid	− 65	97	208
Sulphurous	− 75	230	98
Ammonia	− 75	204	98
Hydric sulphide	− 85·5	186	187·5
Nitrous oxide	− 100	135	173
Chlorine	− 102	250	171
Carbon sulphide	− 110	386	163
Hydrochloric acid	− 112·5	163	160
Phosphorous chloride	− 114	400	159
Ether	− 117·4	313	155
Alcohol	− 130	365	143
Amyl alcohol	− 134	440	139

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

Pressures of Liquid Oxygen.

Temperature.	Pressure in atmospheres.
Centigrade.	
− 129·6	27·02
− 131·6	25·85
− 133 4	24·40
− 134·8	23·18
− 135·8	22·20

− 113 deg. Critical point.
− 50 at. Critical pressure.
Boiling point about − 186 deg.
Density of liquid = 0·89 at − 130 deg.

Boiling Points below the Freezing Point of Water.

	Boiling point below F.P. of water.	Boiling point. Vacuum.
	deg. C.	deg. C.
Carbonic acid	− 80	− 116
Nitrous oxide	− 90	—
Ethylene	− 103	− 142
Oxygen	− 184	− 198
Nitrogen	− 198·1	—
Air	− 192·2	—
Carbonic oxide	− 193	—

Formulæ of Gaseous Laws.

Boyle and Charles $P = \frac{R\,T}{V}$

Van der Waals $= \frac{R\,T}{V-b} - \frac{a}{V^2}$

Clausius $= \frac{R\,T}{V-\alpha} - \frac{}{T\,(V+\beta)^2}$

Amagat $= \frac{R\,T}{V-a} - \frac{M}{Vm+a\,Vm-4K}$

Clausius $= \frac{R\,T}{V-a} - \frac{A\,T^{-(n-1)}-B\,T}{(V+\beta)^2}$

Where B, T, and V are symbols of pressure, temperature, and volume, and R, α, a, b, β, &c., are all constants,

$V\,(1-P\,V)$ = constant (isothermals) Andrews
$P\,(V-a$ = „ „ Amagat.

Fluid Volumes.

1. $V\,t = a + b\,t + c\,t^2$, &c.
2. „ $\frac{1}{1-K\,t}$ (Mendelejeff)
3. „ $a - b \log.(T-t)$. (Waterston).

PRESTON DOCK AND RIBBLE IMPROVEMENTS

As we announced a short time since, the Preston Town Council have decided upon large dock and river improvements, to be carried out from plans prepared by Mr. Edward Garlick, C.E., Preston Dock engineer. The following description of the plan is from a report by Mr. E. Garlick:—The course of the present river—see above engraving—is to be diverted to the Penwortham side of the valley, commencing west of Penwortham Bridge, the diversion crosses part of the Holme, and skirting the foot of the hill north of Penwortham Church, joins the river again west of Chain Caul. The capacity for taking upland floods is made greater in the new than in the present course.

In carrying out this diversion it is proposed to protect the slopes of the sides of the new river with rubble stone, which will be convenient for launching ships from the proposed ship-building yards, on the north bank, where shown by the plan. The new channel will be made as deep as the old one, but on approaching the entrance to the dock it will be deepened to conform thereto.

The dock, which is designed to comprehend 40 acres, is placed in the centre of the Ribble valley, between the new river and the brow at Ashton, and its eastern end is 342 yards nearer the town than that on the deposited map, yet leaving a sufficient space for business purposes and railway springs. The dock is 3240ft. long and 600ft. wide, and contains 6565 lineal feet of quayage, and the jetty will give 2000ft. additional quayage; but in making the dock, preparation for the foundations of the jetty would be made, although the building of it is not recommended until required. The south side and east end of the dock and the jetty are laid out for imports of grain, and imports and exports of general merchandise, the north side being for exports of coal, and for railway sidings, stacking iron, timber, &c

On the north-west of the dock, and connected with it by an entrance, is a timber pond of 25 acres, to be made out of a portion of the present river, extending from the Willows to near the Chain Caul. A dock of 40 acres and a timber pond of 25 acres, with the less lock for small vessels, will prevent the water in the dock falling through lockage to an inconvenient depth during neap tides, which will be a great advantage, as the quay must be 9ft. above high water of ordinary spring tides to prevent flooding. Surrounding the dock is shown on the plan a general design for railways in connection with the Ribble Branch Railway, the West Lancashire Railway, and the intended Manchester, Sheffield, and Lincolnshire and Blackpool railways; also for roads leading to Marsh-lane and Watery-lane, and for warehouses, sheds, and hydraulic coal tips, but these need not at present be finally fixed upon.

Out of the excavation for the dock and diversion of the river, it is intended to raise the land about the dock and Preston Marsh above the height of the greatest floods and the walls of the dock, lock, dock basin, and entrance will be carried up to the same level.

The entrance to the dock is so designed that vessels can sail straight in or out. It is absolutely necessary for the efficient working of the dock to have a dock basin in which vessels can be lying ready to sail out of, or into which those coming in can sail at high water of neap or spring tides. The process of locking vessels into and out of this basin and the dock can be carried on at any time after the tide has receded as well as at high tide; without such a basin all vessels would have to be locked in and out of the dock at the height of the tide of the day, and it will be seen at once that this cannot be done during the short duration of high tide. In short, the entrance to the dock will be worked by vessels being locked out of the dock into the basin, to lie afloat ready to sail away as soon as the tide has risen sufficiently for the entrance gates of the basin to be opened, and all the outgoing vessels can go out of the basin before those coming in from the sea arrive. Vessels coming in will sail straight into the basin, the entrance gates of which will then be closed, and the vessels will lie afloat in the basin ready to be locked into the dock at any time.

Between the dock and the basin is placed the lock, capable of taking a vessel 550ft. long, and all the gates are 66ft. wide, but for the purpose of preventing waste of water as much as possible this lock is divided into two chambers of 225ft. and 325ft. long respectively.

The proposed graving docks are placed near to the dock entrance, away from the general business of the dock, the larger one being in a position available for an additional entrance to the dock, if such occasionally became necessary. They are also near the river, into which they may be, in a great measure, emptied without pumping. Near these graving docks is the hydraulic machinery for working the dock gates, coal tips, capstans, hydraulic cranes for loading and unloading traffic about the dock, and pumping the water out of the graving docks. The site of the dock and entrance has been carefully bored, and it has been ascertained that the foundations of all the walls of the entrance basin, locks, and dock, will be on the solid rock.

It is proposed to carry out the training walls, shown on the deposited plan, for the purpose of fixing the position of the channel of the river in the estuary, and in constructing these walls as much rock out of the bottom of the dock is intended to be used as may prove suitable.

The channel of the river from the dock to the sea is to be deepened by dredging and scour, as shown on the section, namely, to 30ft. below high water of ordinary spring tides, and with a fall of 3in. to the mile. The sill of the dock will be 29ft. below high water of ordinary spring tides. The bar at the sea is 16 miles from the dock and 34ft. below high water of ordinary spring tides. Assuming that a vessel will take three hours to get up or down the river between the dock and the bar, vessels leaving with a draught of 19ft. must get out of the dock an hour before high water; they will then go down with the ebb and carry the same draught over the bar. Vessels entering the dock must cross the bar two hours before high water; and as high water at Preston is an hour later than at the bar, they will have three hours to get up to the dock with the flood, carrying 19ft. all the way. This calculation is for the worst neap tides; at spring tides there will be greater depth, and in all probability after the introduction of the training walls and the deepening of the river, the bar will be lowered and the tide will arrive much sooner at Preston, giving more time for vessels going out of the dock to get over the bar.

Inside the bar there is a depth of 22ft. below low water of ordinary spring tides, and maintaining 18ft. deep for 650 yards along the river course, and 400 yards wide; outside the bar the bed of the sea falls to 42ft. deep at low water at the Nelson buoy, and there is good holding ground for anchorage.

THE BUTTERLEY COMPANY'S WORKS, CODNOR PARK.

THE Butterley Company is one of those few very old English iron companies whose history carries us back to the days when iron was used as little, instead of as much, as possible. It was founded in the year 1790 by Mr. Benjamin Outram, an ancestor of the distinguished general of that name, Mr. W. Jessop, Mr. Francis Beresford, and Mr. John Wright, grandfather of the present proprietors. The interests of the company in Derbyshire, Nottinghamshire, and North Staffordshire are very extensive, especially in the first-named county, and consist of coal-fields and ironstone workings, underlying many square miles of freehold and leasehold property, the numerous shafts being furnished with winding, pumping, and other engines, in some instances of the most modern and powerful character, while in certain places are interesting old things; the Codnor Park Ironworks, the Butterley Ironworks, and the Silverdale Ironworks, extensive limestone quarries and works near Ambergate. To the Codnor Park Works we shall refer hereafter, and describe the machinery we illustrate. The Butterley Ironworks, where the operations of the Company were first commenced, now consists of blast furnaces, foundries, and extensive bridge, roofing, and boiler building establishments, engine factory, fitting shops, timber yard and saw mills, &c. At Silverdale, in North Staffordshire, the company has blast furnaces, foundry, and rolling mills for merchant iron, of which large quantities are turned out, chiefly for the American and other foreign markets. Experiments are now in progress with a view to the production of steel by the Thomas-Gilchrist or basic process, from the company's practically inexhaustible supplies of the rich and valuable red mine and other iron ores of the North Staffordshire district.

The Codnor Park Ironworks cover with their appendages an area of fifty-five acres, and form one of the largest establishments of the kind in the kingdom. They were founded in the latter part of last century, and consist of blast furnaces and foundries, with four blowing engines, Siemens-Martin steel furnaces, and the following rolling mills:—Two 18in. forge trains, one 22in. forge train, one 6in. and 10in. merchant mill, one 16in. and 21in. bar mill, one 30in. bar mill, one 18in. sheet mill, one 19in. plate mill, one 21in. plate mill, and one 28in. plate mill. The forge trains are driven by vertical engines with overhead cylinders, two being high-pressure and one condensing. The merchant and sheet mills are driven by a 60-horse beam condensing engine. A powerful horizontal high-pressure engine is, however, in course of erection to drive the merchant mills, which will shortly be reconstructed to run at a much higher speed than at present—a speed almost double that which was common only a very few years ago. The 16in. and 21in. bar mills and the 19in. and 21in. plate mills are all driven by a fine 120-horse beam condensing engine, the two larger mills being reversed by toothed wheels and clutches, the two smaller being "pull-over" mills. The 30in. bar mill is one of very special magnitude and excellence. It is driven by two independent high-pressure vertical engines, with 30in. overhead cylinders and 40-ton fly-wheels. These engines run in opposite directions, and the train of rolls can be coupled to either of them instantaneously, or detached from both, by a steam clutch, that is, a large clutch actuated direct by a steam piston. On each side of the mill is a traversing platform, which is moved by two pairs of special engines and travels the whole length of the train of rolls, carrying the workmen, and receiving at each pass the bar of iron or steel under manipulation. In this mill steel deck beams of 70ft. long have recently been rolled.

The new plate mill, the formal opening of which was celebrated on the 15th ult., has double sets of 28in. rolls 7ft. 6in. and 10ft. long, the pinions having angular teeth. The motive-power is the fine pair of horizontal tandem compound engines, of which we completed our illustrations on page 463. These have two 30in. and two 50in. cylinders. There is no fly-wheel, the engines being connected with the rolls by gearing of such proportion as to give the engines five revolutions for two of the rolls. The engines and mill are reversed together at each pass of the plate, the link motion being actuated by a hydraulic cylinder, which is worked by water at a pressure of 700 lb. to the square inch, the pressure being derived from an accumulator, supplied by a pair of special pumping engines with automatic regulating gear. The cylinders are provided with piston valves. The main framing is of box section, 4ft. 2in. deep at the slide bar end, and 2ft. 3in. deep at the other end. The plummer blocks are inclined, and are fitted with heavy gun-metal bushes. The crank shaft journals are 14in. diameter, and this shaft is 16in. diameter in the centre. The cranks are of wrought iron fitted with steel crank pins 10in. diameter. The second motion shaft is 18in. diameter in the journals and 20in. diameter in the centre. The gearing is entirely cast steel, and it is double—that is to say, there are two pinions and two wheels, one of each being set a tooth in advance of the other. The pinions have each eighteen teeth 6¾in. pitch, and the wheels forty-six teeth, 6¾in. pitch. The engines work at a pressure of 80 lb. per square inch. It is the intention of the company to make extensive use of hydraulic cranes and other machinery throughout the works. There are for this mill at present four large furnaces in which the iron piles or steel ingots are heated, and these furnaces, as also the boilers which supply steam to the engines at 80 lb. pressure, are worked by gas, which is obtained from a battery of fifteen Wilson's producers. The large engines and the hydraulic engines and accumulators are from the works of Messrs. Tannett, Walker, and Co., of Leeds, and the gas producers were constructed by the Butterley Company from the designs of Mr. Bernard Dawson, C.E. The mill itself has been made at the company's works. The casting of the bed-plates, weighing about 35 tons each, and of the housings, weighing about 16 tons each, was a work of no small difficulty, the successful accomplishment of which reflects great credit upon those concerned. This mill we illustrate on page 463, and as details are given, together with a scale, no description is necessary. Since the day of starting the mill has been very successfully used in rolling steel plates. For shearing the plates rolled by the new mill a splendid pair of shears has been obtained from Messrs. J. Buckton and Co., of Leeds, having cutting blades 10ft. 6in. long, and provided with an admirable arrangement for throwing the moving blade in and out of gear without stopping the engine by which it is driven. These shears, which we illustrated on page 90 in THE ENGINEER, 4th August, 1882, are capable of cutting steel plates 1½in. thick. Amongst the other appliances of these extensive works may be mentioned seven steam hammers of from 2½ to 12 tons, also the ingenious machinery by which the largest rolled girders are constructed with a longitudinal weld along or near to their neutral axis. Amongst the tools are some cutting down shears, by Messrs. De Bergue and Co. which are very highly praised by the manager. In the merchant mill the saws are driven by steam turbines manufactured by the company. These steam turbines are connected direct to the saw spindles, and by avoiding all straps much loss of time is prevented, while the cost of the extra quantity of steam used is as nothing to the saving which is effected by the avoidance of strap slipping and failure, and by the certainty of action at all times, due to their being independent of everything but a supply of steam. Mention must also be made of a fine testing machine by Messrs. Buckton and Co., with an ingenious machine for preparing specimens for testing also from the same firm. Both these machines have been illustrated in our pages, and of the former, as modified for the Indian Engineering College, Cooper's-hill, we shall shortly give further illustrations. There is also a laboratory for making all kinds of chemical analyses. Altogether this plate mill plant may be taken as the most recent example of what modern experience has dictated, and the use of a reversing engine for the purpose is of considerable interest, as bearing on a question much discussed by mill owners.

The different works and mines of the company are connected with each other and with the public lines of the Midland, Great Northern, and North Staffordshire Companies by an extensive system of private railways, requiring for their working no less than twenty locomotive engines. The company also possesses 2500 railway wagons. The freehold estates have an extent of 3000 acres with 800 houses. The spiritual and educational needs of the company's workmen and their families are provided for by churches and schools erected and maintained, wholly or in great part, at the company's charge. At Codnor Park there are waterworks, and an excellent establishment of swimming and other baths. The company has offices in Leeds and Sheffield, and at 118, Cannon-street, London. Amongst the important engineering works which have been executed by the Butterley Company may be named the fine Dordrecht railway bridge in Holland, and the magnificent roof of St. Pancras station, London.

OFFICIAL AMERICAN REPORT ON THE EGYPTIAN WAR.

WE have received a copy of Lieut. Commander C. F. Goodrich's report for the U.S. Naval Intelligence Department—war series, No. III. It is a remarkable work. The writer was present with our forces, and had apparently exceptionally good opportunities of collecting information, and he made use of them to such purpose that he has brought out an excellent report; indeed, we cannot suppose that we have anything better ourselves. More complete statistics as to details no doubt we must have, but we can hardly conceive that there can be anything better than this of its kind. We have seen nothing so good. After a short preliminary sketch, the attack of Alexandria is dealt with. The sketch is just what is needed to introduce the subject. The attack is very fully described; drawings and descriptions of all the ships are given, also of the Egyptian batteries. The injuries to fleet and ports are fully discussed, and illustrated by photographs showing effects. Indeed the report consists of two volumes; one contains the descriptive matter and some drawings, and the other consists wholly of photographs and drawings. The official reports of the captains of the ships are given, and data as to ammunition of vessels and forts. We must not allow ourselves to be entangled in this subject, but we confess to learning one or two remarkable facts which we had not before heard. For example, we read with surprise that the Egyptians had an ample supply of submarine mines, gun-cotton, and fuses, and everything necessary for laying them down, except that only two knots of cable were found. The supply of rifled guns and ammunition was better than we supposed, and there can be no doubt that, with a good artillery commander, a defence might have been made very different from that which was offered to our fleet. Among the general conclusions are the following:—(1) The command of a fort above the sea is of enormous importance; (2) 30ft. of earth will probably resist any projectile now existing; (3) embrasures should be cut deep below the crest; (4) no guns should be mounted *en barbette*; (5) guns should be painted the colour of the works; (6) the average value of armour has been underrated; (7) modern guns with flat trajectories are not the best for attacking earthworks; (8) some ships should carry howitzers; (9) vertical fire should be studied; (10) the largest projectiles are rotated well by rings on their bases; (11) guns firing from barbette towers of ships give special facilities for aiming well—these guns in the Temeraire disappear and do not offer the distinct mark presented by ordinary barbette guns; (12) the ships would have probably acted better at shorter ranges and wasted less ammunition, of which the supply was brought to a "dangerously low ebb;" (13) ships gain more in accuracy by anchoring than they lose in increased exposure to injury—query, does this apply to the case of a skilful enemy? (14) the rising swell of the sea told against the shooting of the ships' guns; (15) ships with fore and aft fire are less affected by swell than others; (16) in attack aim at muzzles of guns visible or any buildings known to be magazines, shot otherwise aimed are thrown away; (17) vessels will never fight on even terms with forts; (18) forts, however, could not stop ships; (19) the spiking attempt made on Mex might have been tried at other places; (20) the forts might have been repaired in a night, and a second day's resistance would have been very serious, with a higher sea and ammunition of the fleet running short.

The land operations are dealt with in Part II. of the volume, and are ably followed throughout; but we must not attempt to deal with them here. The sphere of action of the armoured locomotive train is concluded to be without the limit of the enemy's effective fire. A gun mounted in a train is most useful in defending a long stretch of road, and is powerless for flank attacks. The supply railway and telegraph operations, as well as the actual operations on the field, are well discussed. In conclusion, we may observe that the report we deal with is written in a very sober, unprejudiced tone. We think it would have gained by containing more criticism. The writer is ready to accord praise, and would, we think, be taken for an Englishman were it not for American habits of spelling. We trust that this very able report may be well read in this country.

In the Proceedings of the United States Naval Institute, vol. x., is a translation from the French of the work of M. E. Sarran, on the effects of powder. It is a profound investigation of the subject, which is dealt with mathematically under its different heads. The newest researches of Noble and Abel are discussed. The work is, of course, far too deep even for most professional readers. Its sphere of usefulness is therefore very limited. It follows, however, that it is of the highest value to those who can benefit by it. This translation is very welcome, because though Englishmen are generally pretty well up in French, and mathematical expressions do not require translation, the language is at times cramped and technical. The issue of the work speaks highly for the members of the Naval Institute. To say that it would be Greek to the members of most institutes does not at all express what it is. Twenty people would understand Greek for one that would follow these calculations.

THE SOUTH STAFFORDSHIRE AND EAST WORCESTERSHIRE COLLIERS' STRIKE.

IN view of the expected great strike of colliers in South Staffordshire and East Worcestershire, the following return, showing the rate of wages and the price of Earl Dudley's coal, by which wages have been regulated during the past nineteen years, will be of interest:—

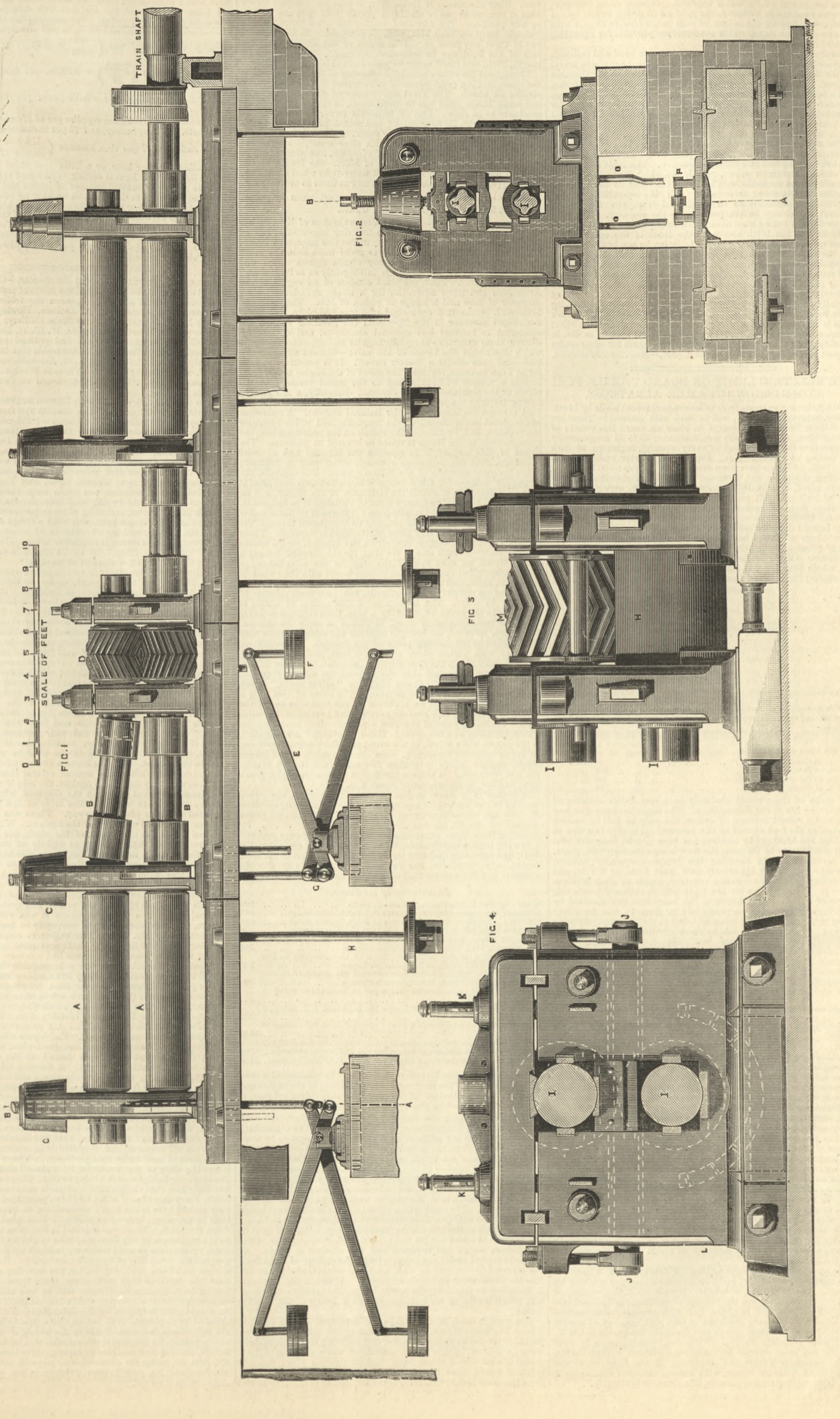
Year.	Dates.	Price of coal, per ton.	Thick coal-miners' wages.	Thin coal-miners' wages, Dudley side.	Thin coal-miners' wages, Wolverhampton side.
		s. d.	s. d.	s. d.	s. d.
1864	July 18	11 4	4 6	3 3	3 0
1868	May 25	10 0	4 0	2 9	2 6
1869	Sept. 29	8 3	4 0	2 9	2 6
,,	Nov. 17	9 3	4 6	3 0	2 9
1871	Sept. 30	10 3	5 0	3 3	3 0
,,	Oct. 13	10 3	5 0	3 6	3 3
1872	Jan. 8*	—	—	—	—
,,	Jan. 24	11 3	5 0	3 6	3 3
,,	Feb. 5	12 0	5 0	3 6	3 3
,,	March 18†	—	—	—	—
,,	March 19	13 0	5 0	3 6	3 3
,,	July 1‡	—	—	—	—
,,	June 29	15 0	5 0	3 6	3 3
1873	Feb. 18	17 0	5 6	4 0	3 9
,,	March 4	19 0	5 6	4 0	3 9
1874	March 11	16 0	5 6	4 0	3 9
,,	July 16	16 0	4 6	3 3	3 0
,,	Oct. 1	13 0	4 6	3 3	3 0
,,	Oct. 5	13 0	4 0	3 0	2 9
1875	June 30	11 0	4 0	3 0	2 9
,,	July 17	11 0	3 6	2 9	2 6
,,	Oct. 1	11 0	3 6	2 9	2 6
,,	Nov. 1	13 0	4 0	3 0	2 9
1876	May 1	11 0	3 6	2 9	2 6
1877	Nov. 1	9 0	3 0	2 6	2 3
1879	May 5	8 0	2 9	2 4½	2 1½
,,	Nov. 1	9 0	3 0	2 6	2 3
,,	Dec. 1	10 0	3 3	2 7½	2 4½
1880	Jan. 1	11 0	3 6	2 9	2 6
,,	April 1	10 0	3 3	2 7½	2 4¼
,,	June 1	9 0	3 0	2 6	2 3
1881	Feb. 1	10 0	3 3	2 7½	2 4½
,,	April 1	9 0	3 0	2 6	2 3
,,	Oct. 1	10 0	3 3	2 7½	2 4½
1882	Jan. 1	10 0	3 4	2 8	2 5
1883	Oct. 8	11 0	3 8	2 10	2 7

* Miners began to work till four o'clock Mondays and Saturdays, and five o'clock the four middle days of the week.
† Miners began to work nine hours per day.
‡ Miners began to work eight hours per day.

TORPEDO BOATS FOR THE RUSSIAN GOVERNMENT.

ON page 466 will be found two external views of the torpedo boat engines, sectional engravings of which, fully dimensioned, will be found on page 442 in our last impression. These engines make 480 revolutions per minute, and are of the lightest possible construction, gun-metal and steel being used to the almost total exclusion of cast iron, save for the cylinders. The pistons are made extremely light, and are packed, the high-pressure with four and the low-pressure with three simple rings, sprung in on the Ramsbottom or Swedish system, as shown on page 442. The bearings are all of great size, the intermediate crank shaft journals being 6¾in. long, while the crank pins are 5½in. long by 3¾in. diameter. The after journal is 12¼in. long, the forward journal 11½in. It is fitted with a square head to take a key for turning the engines by hand. These are very large proportions for a pair of cylinders 10in. and 18in. diameter, 12in. stroke. The condenser is worked by a separate air pump and engine, engravings of which we shall give in our next impression.

A DIFFICULT piece of engineering has recently been successfully accomplished at Niagara Falls, where the upper suspension bridge has been transferred from its old wooden towers to new towers of iron. The work was done by the Central Bridge Works, of Buffalo. The bridge has a span of 1280ft., and the dead weight to be transferred was 528 tons, or 264 tons at either end. This was done on a small bed-plate or saddle 4ft. by 4ft. in size.



SHEET ROLLING MILL, BUTTERLEY COMPANY'S WORKS, CODNOR PARK.

THE BUTTERLEY COMPANY, ENGINEERS.

(For description see page 460.)

ever, as may be seen, a backstand or tailstock of very solid character. The arm is readily removable when desired, or the tailstock can be slid off its seat if required. In most cases, however, the arm need not be removed, the yoke on it being swung up out of the way, leaving the centre of mill arbor free to engage with that on the back stand. This combination provides for operating on a wide range of work.

As shown in the engraving, the space between head and tailstock is about 24in.; but if required, the tailstock can be made to travel in line with the head, and its support be extended to any distance desired. The method of driving the spindle is simple and strong, and allows of free adjustment of the spindle without disarrangement of the driving and feed belts. The cone, which is made for 3½in. belt, is mounted in a stirrup which is pivotted to the bed, and the pinion which engages with the driving gear on the spindle is held at correct distance by a connecting yoke, and is driven by a feather.

The machine has longitudinal feed only, but where it is desired an automatic feed motion can be applied to the elevating screw in the head, giving feed in a vertical direction. The table is arranged to run back rapidly by power, by a device which is not seen in the engraving. As the table weighs 1 ton, the relief to the operator by this improvement is obvious. All the operations of the machine are intended to be conducted from the front side, without any change in the position of the operator. The feed can be thrown out by hand at any moment by means of a rod which connects with the latch shown at the front of the cut, and the power quick-return applied, or the table can be run back by hand, and the feed thrown in by a foot lever, which lifts the drop box shown in front of cut. Adjustable dogs automatically drop the feed motion at any point. The machine is massive in all its parts, and is intended for heavy milling of any description, but more particularly for shafting, railroad or engineering shops, being specially adapted for key-seating long and heavy shafting, finishing guide bars, connecting rods, &c. Its weight is 7500 lb. The work table is 7ft. long by 20in. wide; length of longitudinal feed, 84in.; distance between uprights, 24in. The cast steel spindle is 4in. in diameter, and the mill arbor 2½in. diameter. Arm for outer centre support 5in. diameter at its smallest part.—*American Machinist.*

THE ELECTRIC LIGHT ON BOARD THE U.S. FISH COMMISSION STEAMER ALBATROSS.

THE following extracts from a Government report made by Lieut. Seaton Schroeder, U.S.N., will be read with interest:—There are 136 Edison incandescent lamps in place on board this vessel; of that number, under ordinary circumstances, 40 to 45 are generally in operation the greater part of every evening, beginning at dark and ending at about 11 p.m. During the quarter ending March 31st, 1883, 18 lamps have been disabled, as follows:—10 broken in handling, 4 burned out, 1 burned out by short circuiting of two branch wires, 1 gradually unscrewed from socket, owing to vibration of hull, and fell on deck, breaking the glass and filament; 1 carbon filament broken by caulking the deck above, 1 carbon filament broken while experimenting. The invoice price of each lamp being 1 dol., the additional cost of illumination on account of breakage of lamps has been 18.00 dols., over and above first cost of plant. During the quarter the dynamo machine has run 540 hours. Of the 136 lamps in position 34 have been in operation the whole time, or 540 hours each = 18,360 hours in all; of the remainder, the hours of incandescence have been as follows:—

2—440	hours each =	880 hours.
4—410	" " =	1,640 "
22—340	" " =	7,480 "
8—100	" " =	800 "
20— 50	" " =	1,000 "
18— 10	" " =	180 "
	=	11,980
34—540	" " =	18,360 "
Total	=	30,340 "

The running expense in lamps has therefore been $\frac{18 \text{ dols.}}{30340} = 59$ one-thousandths of a cent per lamp in operation per hour. For illuminating the entire vessel the running expense in lamps has been $\frac{18 \text{ dols.}}{540} = 3\frac{1}{3}$c. per hour. The life of the lamps that have burned out has been as follows:—

No. 49 (8-candle power)	92 hours
No. 90 (8-candle power)	309 "
No. 68 (16-candle power)	195 "
No. 41 (8-candle power)	99 "

A mean of these would obviously be a very unfair showing of the average life of the Edison lamp. The imperfect ones give way first, and a correct average, of course, can only be had by waiting to consider the best as well as the poorest. It is only fair also to add that the breakage by accident has been greater than will probably continue to be the case, the crew being extremely raw, green, and unthinking. In handling the lamps—frequently without authority—they have apparently used more force, as a rule, and less dexterity than the occasion required, simple as their manipulation is. Familiarity with the light will doubtless decrease this source of expense. Furthermore, the lamp that was disabled by caulking overhead was purposely left in place to test its safety under those conditions, it being attached to the deck that was being caulked. The burning of one by short circuiting occurred before the installation of the system was completed, and resulted from the loose ends of two branch wires coming in contact. The destruction of a third occurred during, and was apparently caused by, some experiments, which proved an abnormal condition for an incandescent system of illumination.

As shown above, only four of the eighteen have burned out, which would reduce the legitimate running expense to $\frac{4 \text{ dols.}}{30340} =$ 13 one-thousandths of a cent per lamp in operation per hour, or $\frac{4 \text{ dols.}}{570} = 74$ one-hundredths of a cent. per hour, for lighting the vessel. Some of the globes have begun to be discoloured by the wasting of the filaments—Crooke's effect—but not sufficiently to affect sensibly the amount of light given out.

Apart from questions of economy, the light commends itself strongly for use on shipboard. Its chief advantages over the means of illumination in common use afloat, are:—(1) The absence of heat, smoke, smell, and dirt, and the non-consumption of oxygen; important points at all times, and especially in bad weather, when hatches are closed. (2) The almost absolute immunity from danger of fire; even in cases of short circuiting or arcing between two branch wires, which are the only ones liable to this mishap, the destruction of the safety plug is simultaneous with the passage of the small spark, the circuit being thus instantly broken, and further danger avoided. (3) The great convenience of having it ready to turn on in any place, including the magazine passage, holds or store rooms, where otherwise an oil lamp would have to be used with its peculiar characteristics of dimness, dirt, and danger. (4) Its ability to remain in operation under water, when it may frequently be useful in examining or repairing a ship's bottom, or clearing a hawser from the propeller at night. It is likewise unaffected by rain or wind.

The steadiness of the light and its softness combine to make it most agreeable to the eye, and excellent for reading or working on a chart. The brilliance, of course, depends upon the velocity of the dynamo machine, and the amount of resistance introduced into the circuit of the field magnets; but with average incandescence it is found that ordinary print can be read with comfort on a table by the light of one 16-candle or two 8-candle lamps 4ft. above it, fitted with porcelain shades. With one 8-candle lamp in that position the print cannot be easily read without a tin reflector, which materially affects the dispersion of the light about the room. Four 8-candle lamps, with shades, situated 4ft. above a mess table seating twelve persons, illuminate it brilliantly.

The berth deck of the vessel is 42ft. long, 23ft. average breadth, and 8ft. high. It is lighted by six 8-candle lamps, three on each side. They illuminate it thoroughly, so that the numbers on the bags or hammocks can be read with perfect facility in any part or in any position. The fore-hold has, on the after bulkhead, one 8-candle lamp on each side, with tin reflectors. By the light of one of them any piece of gear or object of any kind on the same side of the hold can be immediately recognised throughout its length, 25ft., and could easily be picked out at a greater distance.

Throughout the entire vessel the efficiency of the illumination is the same, and is a great source of convenience and comfort to all serving on board. The great convenience of the portable hand and stand lamps need not be dwelt upon, as that is the same on shipboard as on shore. One of 16-candle power has been tried as a submarine light, its flexible cord and socket being wrapped with insulating tape. It has been under water, in all, sixty hours so far with perfect impunity. At sea, with clear water, its light has been traced until it reached a depth of 100ft., and after being in operation all one night at a depth of 150ft.—the length of the cord—it was found to be still air and water-tight when hauled up, and is apparently in as good condition now as those in ordinary use.

To the above we add extracts from a report made by passed Assistant Engineer George W. Baird, U.S.N.

The economy of the Edison incandescent system of lighting is a question of commercial as well as engineering importance, and as this is the first Government vessel to utilise this important invention, I have considered it necessary to make more than the usual test of the machinery, that we may obtain figures which will enable the Commissioner to judge intelligently as to its real and comparative value. First, the plant consists of an engine of the Armington and Sims make, having a single cylinder of 8½in. diameter of bore and a stroke of piston of 10in. The engine is horizontal, is mounted on a rigid cast iron bed-plate, and has a centrifugal governor in the fly-wheel; the governor weights are connected to internal and external excentrics, and operate by shifting these excentrics in equally angular and opposite directions, which diminishes the throw of the valve—without affecting the lead—and thus effects a shorter cut-off. It is sensitive, and, so far as I can measure, regulates the speed of the engine to 300 revolutions a minute without regard to the initial pressure on the piston or the resistance on the dynamo. Secondly, a Z dynamo, having its field magnets vertical, the armature revolving in the field between the magnets, in the induced current. A resistance box is placed in the circuit of the magnetic field which regulates the pressure, and, by altering the switch on the resistance box, the incandescence of the lamps is raised or lowered at pleasure. The object of this method is to equalise the internal and external resistance, that the maximum economic effect may be realised; hence the great economy of the Edison system. For example, the dynamo is designed for 120 B lamps of 8-candle power each, and if only sixty lamps be in circuit the resistance of the circuit will be doubled, and the field resistance must be switched in to balance it. Third, there are 139 eight candle-power B lamps of 69 ohms resistance each, placed in multiple arc, and so distributed through the vessel as to illuminate every place where light is required. There are four circuits—of copper wire—from the dynamo, viz., a double circuit—main—on each side of the ship, for the forward lamps; a double circuit on each side of the ship for the after lamps; a single independent circuit for the outside lamps with the switch in the engine room, and an independent circuit for the engine-room. The mains are not only double circuits, but each main consists of two No. 10 wires. The advantage of this system of wiring is manifest; in the event of breaking a wire, from collision or other cause, the remaining wires would be ample to carry the current. The mains, however, are brought together and soldered where they are attached to the binding posts of the dynamo. The wires are insulated with cotton cloth and white lead, and when passing through damp places they are further protected by rubber tubing. On each main wire, and near the dynamo—as well as near each group of lamps—is a "cut-out plug" or "safety catch," which contains a short piece of fusible alloy. The office of this plug is two-fold; it may be used as a switch to cut that wire out of the circuit at pleasure, and also to prevent the heating of the wires beyond the fusing point of the alloy—400 deg.—thus rendering the system harmless as a fire agent. These "cut-outs" are essential, as the copper wires would, in the event of a short circuit, melt and set fire to adjacent woodwork. The absolute safety of the Edison system against injury to human life commends it very highly. The low pressure of 51 volts is insufficient to pass through a man's body, and can, therefore, never injure him.

By means of a steam engine indicator I measured the power required to run the engine and dynamo, the current being switched off. By the same instrument I measured the indicated power required to run 45, 50, and 70 lamps respectively. . . . By deducting from these experiments respectively the power required to run the engine and dynamo, we obtain the power applied to the shaft, and from this quantity we deducted the friction of the load, leaving, as a remainder, the net powers required to revolve the armature in the magnetic field with 45, 50, and 70 lamps in circuit.

Distribution of the Power.

Power required to run the engine and dynamo	3·56
Indicated horse-power required to run 45 incandescent lamps.. ..	5·79
Indicated horse-power required to run 50 incandescent lamps.. ..	5·85
Indicated horse-power required to run 70 incandescent lamps.. ..	6·92
Net horse-power applied to the revolution of the armature in the magnetic field, using 45 incandescent lamps	1·80
Net horse-power applied to the revolution of the armature in the magnetic field, using 50 incandescent lamps	1·85
Net horse-power applied to the revolution of the armature in the magnetic field, using 70 incandescent lamps	2·84
Mean number of incandescent lamps per indicated H.P. using 45 lamps	7·77
Mean number of incandescent lamps per indicated H.P. using 50 lamps	8·50
Mean number of incandescent lamps per indicated H.P. using 70 lamps	10·11
Mean number of incandescent lamps per net H.P. using 45 lamps..	25·
Mean number of incandescent lamps per net H.P. using 50 lamps..	27·02
Mean number of incandescent lamps per net H.P. using 70 lamps..	24·63

The wires being fixed, their resistance may be considered a constant quantity and the only variation as existing in the engine and dynamo; the distribution of the power as above recorded may, if necessary, be verified by electrical measurements on the wires.

The cost of running the incandescent lamps, as compared with coal-gas lighting, is a matter of commercial as well as engineering interest, and it is my purpose to confine the comparison to these objects alone. From the quantities determined and recorded above, these comparisons are made, candle-power for candle-power. So far the greatest number of lamps in operation at one time has been seventy; we ordinarily use from forty-five to fifty. The number of lamps per indicated horse-power increases with the number of lamps used, for the reason that the engine works more economically at higher powers. The comparison between these incandescent lamps and light from coal gas, as measured by a photometer, is not a fair one, inasmuch as the gas-burner itself—to say nothing of part of the fixture—is under the jet and casts a shadow underneath, while the Edison lamps are inverted and the shadow is above. As the light is used under the lamp, a larger percentage of light from the inverted fixture will be cast upon the work beneath, and for this the photometer makes no reduction. Although the B circuit is installed to give 8-candle power lamps, they really emit about ten, which is also an unbalanced account in favour of the electric lamps.

The cost, in coal, of a horse-power developed by the dynamo engine has been arrived at by calculating the quantity of steam passed through the steam cylinder, and reducing this to pounds of water, and dividing this by the pounds of water evaporated by a pound of coal. Had steam been used for lighting alone, this calculation would have been unnecessary, but as steam was used, from the same boiler, to warm, ventilate, and light the ship at the same time, the writer adopted this method of separating the respective powers. From these indicator diagrams I have calculated that a horse-power costs 30·7 lb. of water or 3·41 lb. of coal per hour. The cost of the coal was 4·60 dols. per ton, and the lubricating oil 65c. per gallon. The consumption of oil is one quart in six hours, so that the cost to us, to run the dynamo during the 70-lamp experiment, was $\left(\frac{460}{2240} \times 3{\cdot}41 \times 6{\cdot}92\right) + \frac{65}{4 \times 6} =$ 7·553c. per hour or $\left(\frac{7{\cdot}553}{70}\right) = 0{\cdot}1079$c. per lamp per hour, or $\left(\frac{0{\cdot}1079}{8}\right) = 0{\cdot}0135$c. per candle-power per hour. The coal gas company of Washington supplies gas of 17-candles power, used from a 4ft. bat-wing burner, at 1·75 per thousand cubic feet. The cost of such a jet of gas then becomes $\left(\frac{175 \times 4}{1000 \times 17}\right) = 0{\cdot}041176$c. per candle-power per hour, or a little over three times what the Edison incandescent light is costing us on board this ship.

I have purposely omitted the cost of labour and the interest on the money invested in the plant, as we have no additional men for running the dynamo or engine, the officer on watch attending to it in addition to his other duties. The interest on the plant at 6 per cent. is only (3500 × 0·06 dols. =) 210 dols. We use about fifty lamps about six hours per day, so that the interest on the money invested is about $\frac{2}{100}$ of a cent per candle-power per hour, or hardly worth considering.

MIDLAND INSTITUTE OF MINING ENGINEERS.—On Wednesday a general meeting of the members of the Midland Institute of Mining Engineers was held at Barnsley, when the following gentlemen were elected members:—Mr. A. Jackson, Howley Park Colliery, Batley; Mr. J. Jarratt, Houghton Main Colliery; Mr. W. Bailes, manager Corton Wood Colliery; Mr. W. Short, Lambton Colliery. The following papers were read and ordered to be printed:—"Instantaneous Outbursts of Inflammable Gas in Coal Mines of the Belgian Basin," by Mons. A. G. Armould, communicated by Mr. W. T. Embleton; and "On Visits to Foreign Mines," by Mr. A. Lupton, of Leeds. A discussion ensued on two papers read at previous meetings.

HIGH RAILWAY SPEEDS IN THE UNITED STATES.—Mr. Wm. H. Vanderbilt's special train of two coaches ran from Lima to Dayton, May 8th, 74 miles in 64 minutes = 1·155 miles per minute, or 1 mile in 51·9 seconds. From Dayton to Hamilton, 35 miles, was made in 36 minutes. The entire trip from Detroit to Cincinnati 263 miles, over the Canada Southern, Dayton and Michigan, and Cincinnati, Hamilton and Dayton, was done in 5 hours 30 minutes, or 50·7 miles an hour, making several stops and changing engines at Toledo, Lima, and Dayton. The run from Toledo to Cincinnati was made with three engines. The first was a Rogers 15 by 22, with 60in. drivers, making Toledo to Lima in 96 minutes, including three stops—actual running time 75 minutes. The second run was with a Grant engine, 15 by 22, with 66in. drivers, making 71 miles in 93 minutes—stopping for four crossings and slowing through five towns. The third run was by a "Cincinnati Shop," 16 by 24 engine with 66in. drivers, making 60 miles and five stops in 69 minutes.

THE EMPLOYERS' LIABILITY ACT.—An action was recently brought in the Nottingham County-court, under the Employer' Liability, against Messrs. Foster and Barry, of Radcliffe. It was a claim for £210 for an accident to James Wheatley, the husband and father of the plaintiffs, which terminated fatally on the 9th January last. Deceased was employed at a storm-water culvert on Sneinton-road. William Campion, a banksman, stated that on the day in question he was working at the culvert winding sand up the shaft. Witness afterwards carried some pieces of coal from the outside to the inside of the enclosure of the works. He put the coal down and was winding a windlass to draw up sand when the witness Neaster came up to him with the deceased who had been injured. Shortly before the accident happened witness saw a piece of coal lying under the platform about 3ft. from the mouth of the shaft. By his Honour: Witness did not remove it; he did not know why. No one told him to fetch the coal from the outside of the works. The foreman was not near witness at the time. James Neaster, sub-contractor, said he was in the employ of Messrs. Foster and Barry, and at the time he was digging sand close to the bottom. Witness heard a groan, and on turning round saw the deceased falling, and noticed several lumps of coal which appeared as if they had fallen against the side of the pit and split into pieces. Witness picked up the deceased, who was insensible. The top of the shaft was above the level of the platform, which consisted of balks placed crossway. There was an open space between the ground and some of the timbers. Witness never saw any coal or stone at the mouth of the shaft, nor underneath the platform. There was a fire kept nightly at the mouth of the shaft for warmth and refreshment. Cross-examined by Mr. Stanger: He could not say whether the foreman allowed the fire or not. The heap of coal outside was to supply the fire, which was really lit for the protection of the public. This was 36ft. from the shaft. The ground sloped upwards towards the mouth of the shaft, and it was quite impossible for the coal to get into the shaft unless it was violently kicked or thrown. A man was employed purposely to look after this fire. Re-examined by Mr. Perry: The engineers considered that the guarding round the top of the shaft was quite safe. His honour said he was of opinion that the case had not been brought within the meaning of the Act. It was a lamentable thing that a man should have lost his life and have left a widow and children, and no one probably lamented it more than defendants in the action. He was certain that the defendants would have a feeling for their own workmen. This was a case in which they were seeking to fix liabilities under the Employers' Liability Act, a most useful and admirable Act in his opinion. The Act protected the interest of employers as well as employed. Employers who engaged sound and proper men, under a sound and good plan, with proper material, did all that they were bound to do, and everything which was reasonable and right. A witness told them upon his oath that the plan was a properly sound and correct one for the purpose for which it was designed. There was no mention that any defect had arisen owing to the negligence of the employers. If there was anything wrong it was a defect in the sense that the planks ought to have been put all round the shaft, so that a piece of coal, which might otherwise have fallen down, could not have fallen down. They had the fact that the machinery was fit and proper in all respects, and they had it in evidence that, if there was a piece of coal under that platform, in a bare plane like that, it was the duty of the workmen to make all clear, and not make the employer liable for such a thing as that. They had entirely failed to satisfy him that the plaintiff had made out a case under the Act. —Mr. Perry said that if a fire had been permitted to be put there, they should have taken extra precautions to prevent coal if possible by any slight kick or anything of that kind, to have fallen down the shaft. There was a defect in the plan which was owing to the negligence of the foreman, who ought to have taken such extra precautions as were necessary to block up the two sides, and prevent the possibility of anything occurring. He submitted that a case had been made out within the meaning of the Act, and that the death of that man arose from those precautions not having been made. His Honour said he was still of opinion that no case had been made out within the meaning of the Act, and he should give judgment for the defendant. Mr. Stanger said he should like to observe that before these proceedings were taken, the defendants had offered £10 to the widow of the deceased, out of compassion for her, and a subscription was also started on her behalf, but she had declined to accept. His honour: Of course, Mr. Stanger, under the circumstances you will not apply for costs. Mr. Stanger: No, your honour, defendants are quite satisfied.—*Nottingham Journal.*

TO CHICAGO IN EIGHTEEN HOURS.*

By ROBERT GRIMSHAW, M.E.

I HAVE the honour this evening to submit to the Franklin Institute the outlines of a bold but feasible project for making the regular run between New York or Philadelphia and Chicago in eighteen hours, with comfort, safety, and cheapness. At present the transit occupies from twenty-seven to thirty-seven hours, according to the route and the character of the train. To accomplish the desired result necessitates changes of engine, train, method, and permanent way. Naturally the limits of this paper do not permit me to rehearse all the details of the proposed selections and innovations; but the most important of them will be outlined, as a basis for discussion. This paper is the outcome of a discussion started by me in the *American Journal of Railway Appliances* in December last; I have no patents to advertise and no axes to grind. Many of the suggestions in this paper are mine, others have been contributed by eminent mechanics, practically familiar with the building, repairing, and running of high-speed locomotives. I do not, however, propose to designate what are mine and which are not, having been much amused by hearing ideas contributed or endorsed by leading builders and master mechanics, and some of which have been for some time in successful operation, characterised as impracticable and visionary. All I will say in this connection is, that whatever any of my hearers may consider as good and practical, no matter what it is, I do not claim. For anything which any one may consider particularly good for nothing, or old, or wild, or unfeasible, or idiotic, I accept full responsibility. I am perfectly aware that this will result in my at once fathering and disclaiming all those ideas about which among my hearers there may be diametrically opposed opinions; but the inconsistency will be not mine, but that of the audience. For such work the engine needs, in a high degree, steaming capacity and economy of fuel, cylinder power and economy of steam, tractive power, adaptability of wheel base to the curves necessarily encountered, proper equalisation and distribution of weight, prompt and safe control by throttle, reverse lever, and brake, exemption from tendency to leave the rails, particularly on curves and at switches; freedom from jerking, swaying, "wee-wahing," and hammering, and good behaviour as regards spark throwing and heating of wearing surfaces. This is, perhaps, asking a good deal in an engine; but the higher the standard and requirement, the better the attainment; and in all the points named existing engines can be bettered. Steaming capacity and economy call for good fuel and water, and proper draught, large grate, and heating surfaces properly disposed, the grate kept properly covered and fire clean, water heated and purified before feeding; heating surfaces kept free from scale and sludge on one side, and soot and ashes on the other. Cylinder power and economy demand high initial and mean effective pressures and low terminal and back pressures. This must be got by large port area without excessive passage clearance, and a better valve motion than the present shifting link abortion, with its attendant throttling, wire-drawing, exhaust choking, and lop-sided distribution. To get high tractive power, the drivers must have as much weight upon them as the rails, joints, and bridges will stand. There is no use in an engine being more than able to slip her drivers on up grades, and with a maximum train load, on icy rails. We must distribute our reforms among the framing, running gear proper, fire-box and appurtenances, boiler proper, stack, valves and steam passages, and valve gear. Perhaps the necessity for simultaneous reforms in so many elements may result in a hybrid type of engine; but it must be remembered that many hybrids are useful; one of them, the much maligned mule, is an indispensable factor in civilisation. For framing, I should select the bar type as perhaps the best understood by American builders, and best adapted to the permanent way of the next decade. But it requires marked reform from the usual manner of making up. It needs to be stiffer vertically, to be better braced diagonally in a vertical plane, and freer from short, sudden changes in direction, and from welding flaws. It should be of mild steel, die forged by pressure, as by hydraulic or steam toggle-presses, instead of anvil forged by hammer blows. The angles should be well reinforced, and the whole frame considered as a truss subjected in its various parts to certain constant and known weight stresses, plus other intermittent racking, twisting and pounding strains. I trust that master mechanics and locomotive builders will pardon me for saying that the services of a good bridge engineer could be employed with advantage in

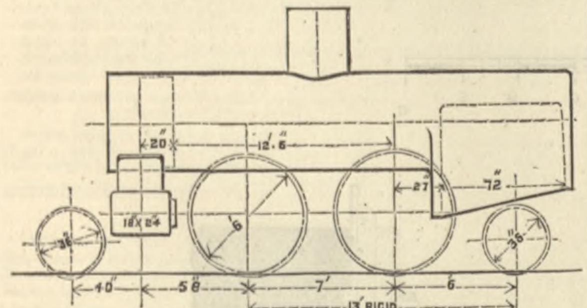
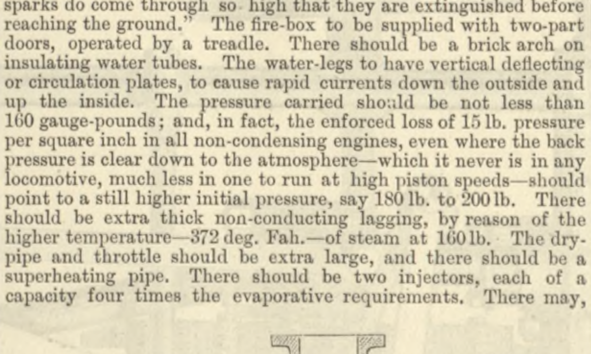


FIG.1

FIG. 1.—PROPOSED WHEEL DISTRIBUTION.

re-designing the framing of high-speed American passenger engines. I would propose for each horizontal member of the bar frame a beam rolled of ⊥-section, with considerable depth of web; jaws of same section, but with considerable reinforce welded in the framing angles. For wheel distribution, I propose two pairs of drivers, a "pony" or single pair leading truck, and a pony trailing truck. Objection has been made that pony leaders are dangerous, and that a four-wheeled truck is necessary for safety. In reply to this, English fast engines have even rigid leaders, and often lead with the drivers. I know of no instance where a locomotive has been derailed, owing to the pony truck, where the pony truck has been equalised with the front driving wheels. A four-wheeled leading truck would increase the length of boiler and flues, and the dead weight of boiler and running gear, and not increase the traction. Proposed diameter of drivers is 72in., placed 84in. between centres; of leading truck wheels 36in., 99in. in advance of leading driver centres, of trailing truck wheels 36in., 72in. back of rear driver centres. The trailing truck must be rigid, giving 13ft. rigid wheel base and total wheel base of 21¼ft. Or the trailing wheels may be on a swinging bolster pony truck if necessary, which would make the rigid wheel base only 7ft. The proposed wheel base distribution may be seen in the diagram, Fig. 1. Two pairs of drivers are chosen because, although single pairs do the best work in England, they are harder on the permanent way and cannot climb away so well from a station if the grade is anything to speak of and the rails are slippery. All engine wheel centres to be press forged of mild steel, with hard and tough steel tires 1in. greater diameter than the centres, the interstitial ring being hemp packed by steam or hydraulic pressure to absorb shocks and vibrations. Centres and tires of all wheels to be given a running balance while turning on a cock-head, and the completed wheels to be similarly balanced when put together. Particular attention to be paid to counterbalancing reciprocating parts, and the balance attained to be such as to lessen vertical irregularities rather than fore and aft pulls. The flanges of all wheels in the train are to be of extra depth and thickness, and those of the front drivers to be lubricated by grease blocks as on Austrian railways, to lessen flange friction and wear of rails and flanges. Rear drivers to be either flangeless, or with extra play in the wheels, in case the trailing pony does not have a swing motion. Axles to be of mild steel with 10½in. by 8in. journals in phosphor bronze or equivalent bearings. Journals to be formed by pressing a ground hard steel sleeve over a mild steel centre and then forcing on the wheel. Power brakes to be applied on both sides of each driver, so as to give increased friction and prevent strain and wear on axle-boxes, and on brasses of main and side rods. As regards the brake, I make the following quotation from the *American Journal of Railway Appliances*:—"An important requisite is suitable and adequate brake power. This is of the first importance for safety, convenience, and expedition. (1) As already intimated, the power brake for such a train must be easily graded. For slow-ups, through centres of population, around curves and down grades, a brake is needed which will not go off like a cannon—using all its power when but part is required—but one which may be applied to just the extent which the engineer may desire, and no more. And this grading in brake power must be attainable without any mechanical change in the equipment other than that which may be effected instantaneously in the cab. (2) The needed brake must indicate accurately to the engineer, at any moment, the amount of brake power he has, not only on his engine, but also on his train. (3) It must be a brake which will at once give notice of any damage to any part of the train, without necessarily bringing it to a halt in a dangerous place. Or, in other words, the brake must apply automatically in case of damage, to remain set, or be instantaneously released, at the will of the engineer. (4) The brake equipment should be so devised that even a considerable damage to it will not disable the brake. (5) The efficiency of the brake should not be affected by sudden changes in temperature. (6) It should be free from liability to trouble from lack of equalisation in the power applied to separate cars. (7) The brake power should be adequate, instantaneous in its application and release, and available at all times, in whole or in part. (8) It should be cheap, and as cheaply maintained as is consistent with the highest degree of efficiency and safety. (9) Above all, it should be free from any liability to creep on and stall trains." Springs to be in two parts, separated vertically by an open space and a central distance piece, so as to give by this open trussing greater strength for a given weight of metal. In the matter of fuel, there are four classes to choose from:—(1) lump coal; (2) "briquettes," or blocks of artificial fuel made from screened anthracite or bituminous slack, mixed in suitable proportions, and compressed by hydraulic machinery; (3) water gas, made in fixed plants at terminal and other stations, and compressed to fifteen or twenty atmospheres in cylindrical mild steel tender tanks or reservoirs; and (4) petroleum, vaporised or sprayed at the moment of burning, and at the varying rates required for the constantly varying work to be performed. The artificial fuel of briquettes has the advantage of cheapness and compactness and of regularity in firing. Either compressed water gas, or petroleum, would give lightness of tender, and regularity and rapid and absolute controllability of evaporation, together with great capacity and high duty. For the present we shall consider the engine to be designed for lump coal, or for "briquettes" of compressed coal slack. Boiler to be of $\frac{7}{16}$in. mild steel, 56in. outside diameter, straight top made with only one longitudinal seam, and that on top; holes either drilled or punched scant or reamed to size; hydraulic rivetted and concave caulked; manhole to come in the dome and be reinforced with a mild steel ring. I would prefer to do without the longitudinal seam by having the rings rolled seamless, or to do away with the girth seams by making the entire shell of one sheet, but at present neither of these plans can be carried out. Distance from centre of front sheet to centre of stacks, 20in. Crown sheet 27in. back of rear driver centres. Thickness of dome, ⅜in.; of extended smoke-box, $\frac{5}{16}$in.; of smoke-box, ½in. Height from top of rail to centre of boiler, 7ft. 3in. Two hundred and thirty-five basic steel tubes, each 12ft. 6in. long between tube sheets, and 2in. outside diameter. Objection might be made to the great length of tube, but they are only a foot or so longer than usual, and need give no trouble as regards tightness. This gives an external heating surface of tubes of 1537 square feet, and a fire area through tubes, less ferrules, of 3·92 square feet. Fire-box, 120in. long and 52in. wide, inside. Height of crown sheet above top of grate, at centre, 52in. Material of inside fire-box copper, ½in. thick at sides and front, ⅞in. at back and ½in. in crown. Radial stays, forked at the crown sheet end. Heating surface of fire-box, 84 square feet, making a total heating surface of 1621 square feet. Exhaust nozzle, if discharging into stack, 3in. by 3½in., instead of 2½in. by 3½in., as is usual for 18in. by 24in. cylinders. Duplicate sets of try cocks and glass water column, and regularly renewable fusible plugs, kept free from scale. The fire-box may be corrugated to give increased strength and surface, and permit of expansion and contraction without causing leaks. If coal or briquettes are used, there will be a spring fire-door, operated by the stoker's foot; a deflecting plate inside the fire-door; a perforated bridge-wall, and arrangements for admitting either steam or heated air at will through the bridge-wall, or in the side walls, or in the closed ash-pan, which latter will have an air-tight "slat dump." The grate bars would be mostly water tubes, and there would be rocking sections for cleaning. There would be a live steam-blower in the stack. Smoke-box to be of the "extended" class, with spark arrester. Experiments with the extended smoke-box on the Eastern Railroad show that "the engine will make steam with her exhaust tips from ⅛in. to ¼in. larger in diameter, with the extension" than without; that it gives 15 per cent. minimum fuel saving; lessens smoke, and "throws whatever sparks do come through so high that they are extinguished before reaching the ground." The fire-box to be supplied with two-part doors, operated by a treadle. There should be a brick arch on insulating water tubes. The water-legs to have vertical deflecting or circulation plates, to cause rapid currents down the outside and up the inside. The pressure carried should be not less than 160 gauge-pounds; and, in fact, the enforced loss of 15 lb. pressure per square inch in all non-condensing engines, even where the back pressure is clear down to the atmosphere—which it never is in any locomotive, much less in one to run at high piston speeds—should point to a still higher initial pressure, say 180 lb. to 200 lb. There should be extra thick non-conducting lagging, by reason of the higher temperature—372 deg. Fah.—of steam at 160 lb. The dry-pipe and throttle should be extra large, and there should be a superheating pipe. There should be two injectors, each of a capacity four times the evaporative requirements. There may,



FIC 2

FIG. 2.—SUGGESTED VALVE AND PISTON ARRANGEMENT.

perhaps, be a "blow-back valve," discharging the escape from the safety valve into the tender, for the treble purpose of quieting the noise, economising fuel, and lessening the damage done the sheets by injection of cold feed. The blast to be supplemented by controllable jets of superheated live steam introduced at the front and sides of the fire-box. Cylinders, as before stated, to be 18in. by 24in. If a D valve be used, which is not recommended, it should be of the Allen type, with 6in. travel; the upper line of the steam edges to be worked to a quarter circle to assist in the flow of steam. The steam chests, if a D valve be used, to be on the sides of the cylinders, or else spring relief or shifting valves to be supplied to lessen danger from water working over. Steam ports for D valve, instead of 1½in. by 16in., as is usual, to be 1½in. by 20in. at the valve seat, with passages tapering down to 1½in. by 16¾in. at the counter bore. This is to give 25 per cent. more area with a given port opening than is usual for steam admission at early cut-offs, giving with $1\frac{1}{5}$in. width of port uncovered, an effective open port area of $1\frac{1}{5}$in. × 20in. = 24 square inches at the valve seat; the maximum admission area at the counter bore being only 1½in. × 16¾in. = 25⅛ square inches even when the port is fully uncovered. Valve gear to be of the Joy or other radial type; preferably of such construction as to give full port opening in ⅛ of its travel, stay open during the next ¾, and close during the final ⅛ travel; lead and cushion to be equalised, rather than cut-off and release; and the valve gear to be so proportioned and adjusted as to do its best work at that point of cut-off most used. On no account should any type of a link motion be used. Preferably, the steam distribution to be by four cylindrical valves across the heads, having reciprocating partial rotation; running in oil under steam pressure, taking steam under the lip; hung on hardened steel trunnions, bearing on hardened steel bushes; motion from the crosshead—Fig. 2. Piston to be spring-packed with rings scarfed by a cut half-way through the width of the ring, then round the ring 3in.; then the other half-way through, so that, as the ring wears, the sides of the circumferential cuts always touch. Piston to be lubricated by oil passing from a cup on the crosshead through a central drill hole in the piston-rod to the centre of the top of the piston head—Fig. 2. Piston-rods and valve-rods to be steel, and metal-packed by a spring-packed collar

FIC 3

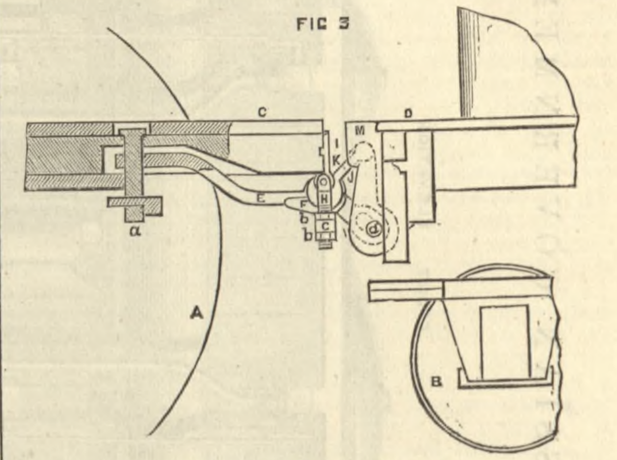


FIG. 3.—AUTOMATIC TRACTION INCREASER.

fast to the rod, and playing steam tight, though without binding, in a bored cylindrical box. [As an alternate, Babbitt-bushed stuffing boxes, 4 rod diameters in length, bored $\frac{1}{1000}$in. larger than the rods.] Crosshead to be of steel, of the vertical type, with adjustable phosphor bronze shoes playing on two cast iron guides of diamond section. Wrist pin, fast in the rod, and playing in two bronze-bushed bearings, one at each end, in the crosshead. Preferably, all the journals to be formed by forcing a hardened steel sleeve over a mild steel centre. All pins and cylindrical journals to be turned, and ground on centres. Crank pins to be oiled by graduating cups with spring valves, which give down a fixed charge of graphited oil at each stroke, and will not run dry when the crank is on centres. Parallel and main rods, rectangular section; the connecting rod largest at the crank-pin end. The parallel rods would have solid ends, and brass bushes pressed in. While this arrangement costs a little more at first, a bush fits the pin better than keyed brasses. Solid ends for rods have the advantages that a careless engineer cannot key up so as to injure the rods; there are no keys to become loose, and no bolts to clear. Connecting rods taking hold outside of the wrist pins have been objected to by Westerners as causing undue spread of cylinders, and hence

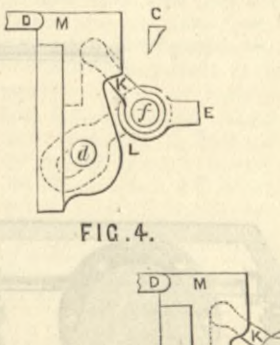


FIG.4.

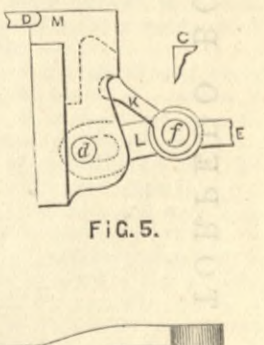


FIG.5.

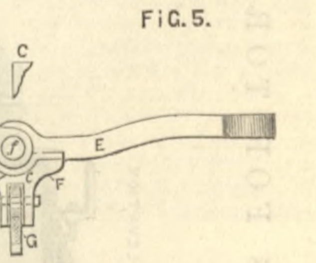


FIG. 6.

causing swaying. These objectors do not, perhaps, know that all Pennsylvania Railroad passenger engines are built with the rods taking hold of the wrist pins, and give no trouble on this score. The sand-box could go well down against the wheel case, as in British engines. Increase of traction on grades and curves is not to be got by sand alone, perhaps not at all by sand, but by an automatic traction increaser, capable of putting a maximum of 10 tons to 15 tons extra weight on the drivers, from the tender—see Figs. 3 to 6.

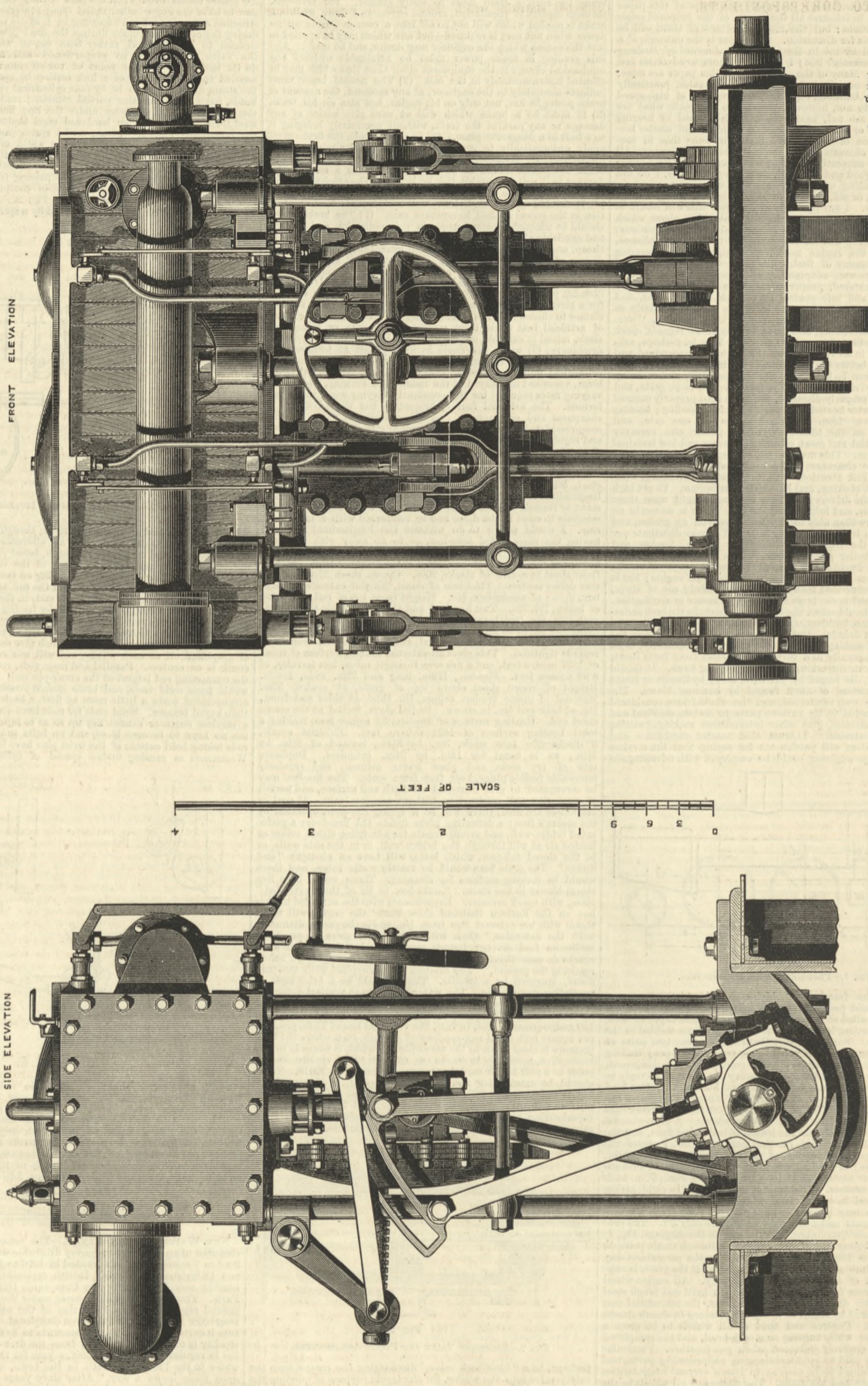
(*To be continued.*)

* Read at the Stated Meeting of the Franklin Institute, April, 1884.

NEW WATERWORKS IN VENICE.—The concession for the construction of an aqueduct to convey drinkable water from the mainland to Venice, which was granted in 1876 to Messrs. Ritterbandt and Dalgairns, representing British capitalists, was subsequently handed over by them to the Compagnie Générale des Eaux, of Paris. The aqueduct, which passes under the lagoons, the underground pipes, for the distribution of the water, and two large reservoirs in the town, have been completed. The total expenditure incurred by the company amounts to 5,000,000f. The municipality is to pay the company from the first day the waterworks are in regular operation 100,000f. a year for the supply of potable water to the 120 public wells in the town, which are to remain open three hours a day. After sixty years the waterworks are to become the property of the municipality. Private families will be provided with water at the price of 60c. per cubic metre—1000 litres—and the company will also make special arrangements for the supply of larger quantities of water at lower rates. The minimum quantity of water which the company will furnish is 250 litres per day. The water is to be taken from the canal "Dei Moranzani.

ENGINES FOR TORPEDO BOATS FOR THE RUSSIAN GOVERNMENT.

(For description see page 460.)



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SHEFFIELD.—*It certainly was not the Royal Society. It might have been the Inventors' Institute.*

E. M.—*Apply to the Secretary of the Sanitary Institute of Great Britain, 9, Conduit-street, W.*

E. R. B.—*Your arrangement would work if you could get rid of backlash, which would, we fear, take place.*

DYNAMO.—*You can run the gearing you propose with perfect safety, but it will be noisy, and the pinions will not last long.*

J. D.—*As we understand your reversing gear, it would not work with certainty, because the teeth may pitch on their points instead of gearing with each other when the gear is put into operation.*

W. J. (Chester).—*Your air pump will give you no trouble whatever at 90 revolutions of the engine, or at twice that speed. Use india-rubber disc foot and bucket valves, one of each, beating on grids, and give them a small lift, say ⅜in.*

A. L. (Inverness).—*The discharge over your weir is about 60 cubic feet per minute; this, with a fall of 5ft., is a little over half a horse-power theoretically. Practically a water-wheel would give you about one-fourth of a horse-power, which would drive a small lathe, blow a smithy bellows, or run a drilling machine. It would do about as much work as three average men turning a crank. To employ the water to the best advantage a small overshot wheel about 8ft. in diameter and 2ft. wide should be used, making about 12 revolutions per minute. A hurdy-gurdy wheel would not be suitable, because the head is not sufficient. The best results are got with very high heads, such as 200ft. or 300ft.*

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

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

MEETING NEXT WEEK.

CHESTERFIELD AND DERBYSHIRE INSTITUTE OF MINING, CIVIL, AND MECHANICAL ENGINEERS.—The annual general meeting will be held in the Stephenson Memorial Hall, Chesterfield, on Thursday next, at two o'clock. Papers by Mr. Henry Fisher "On a System of Endless Rope Haulage in use at Clifton Colliery, Nottingham, with Remarks on Various Clutch Gears in use, and a Description of a New Frictional Clutch for Hauling Engines and other Machinery," and by Mons. J. B. Marsaut, entitled "Miners' Safety Lamps" (translated), will be open for discussion.

DEATH.

On the 15th inst., at his residence, Penwortham, Birdhurst-road, South Croydon, JOHN LYON ALEXANDER, C.E.; also of No. 12, Delahay-street, Westminster, in his 63rd year. R.I.P.

THE ENGINEER.

JUNE 20, 1884.

SIR JAMES PAGET ON HEALTH.

ON Tuesday afternoon about a thousand ladies and gentlemen dotted the vast expanse of the Albert Hall. They had been invited to be present at the ceremony of introducing the jurors for the Health Exhibition to the Prince of Wales. There was no ostentation about the performance, but a very considerable amount of speech-making, entirely inaudible in the balcony for which the larger portion of the tickets had been issued, the boxes being left empty—a singularly injudicious arrangement. Addresses or speeches, we hardly know which to call them, were delivered or made by the Duke of Buckingham, Sir James Paget, Sir Lyon Playfair, and the Prince of Wales. The jurors were introduced to the Prince, filing past him and making their bows. Every one we imagine was glad when the thing was over. The utility of the performance was questionable, and it was not ornamental. We are, however, pleased to know that at last jurors have been got together. This was not accomplished without some difficulty. We trust that the jurors may have no reason to regret their acceptance of onerous duties more or less unappreciated by hosts of exhibitors. At one time it was deemed an honour to get any award at all; now no one is satisfied unless he gets a gold medal. The usual crop of bickering and contentions will be sown, and, of course, bear fruit—unless, indeed, the atmosphere of the Health Exhibition gives that tone to the mind of exhibitors which sanitary perfections of all kinds are supposed to impart.

The most noteworthy feature in Tuesday's performance was Sir James Paget's address, which is very remarkable. He has broken new ground altogether, and estimates the results of sickness in terms of labour. He has carefully collected statistics which show that in round numbers males between fifteen and sixty-five lose, on the average, nine days per annum, during which they are incapacitated by ill-health from working. "Briefly," says Sir James, "it appears from these tables that the average time of sickness among males during the working years is 1·314 weeks—that is, a small fraction more than nine days each in each year—and that among females it is yet a small fraction more. The result is that among males there is a loss of 9,692,505 weeks' work in every year, and among females a loss of 10,592,761 weeks. Thus we may believe that our whole population between fifteen and sixty-five years old do, in each year, 20,000,000 weeks' work less than they might do if it were not for sickness." No one, so far as we are aware, has ever put facts like these before the world. The system is interesting, and even attractive. The worst of it is that it may be developed in a way that Sir James Paget scarcely, we think, contemplated. He put his statistics into the form of money. "Try," said he, "to think of it in money. Rather more than half of it is lost by those whom the Registrar-General names the domestic, the agricultural, and the industrial classes. These are rather more than seven millions and a-half in number, and they lose about 11,000,000 of weeks; say, for easy reckoning, at a pound per week, and here is a loss of £11,000,000 sterling from what should be the annual wealth of the country. For the other classes, who are estimated at losing the other 9,000,000 weeks' work, it would be hard and unfair to make a guess in any known coin; for these include our great merchants, our judges and lawyers, and medical men, our statesmen and chief legislators; they include our poets, and writers of all kinds, musicians, painters, and philosophers; and our princes, who certainly do more for the wealth and welfare of the country than can be told in money." This is a very striking statement. Sir James' net takes in all sorts of fish, big and little.

It is not for a moment to be disputed by any sane man that it is desirable that he himself should be as healthy as possible. He will also naturally wish that all his own family, and possibly a good many of his neighbours, should be healthy. Sir James Paget argued to most willing ears when he advocated the charms of health; but it is open to question if his statistics possess any real value. We have no fault to find with his intentions; even his method of expressing his views has the merit of being extremely ingenious, novel, and striking. We suppose it is scarcely necessary to add—although we do it to avoid the least chance of misconception—that we are at one with all those who would promote the health and progress of the human race. But we cannot refrain from expressing our doubts that Sir James Paget's statistics possess any great value as enforcing truths which may be safely advocated on far higher and nobler ground than he has taken. His political economy is of questionable soundness. His entire argument is based on the assumption that there must always be plenty of remunerative work, which could be done by those who are sick if they were well. At the outset it must be pointed out that Sir James deals with the most deceptive things in the world—averages. It has often been pointed out—and the statement has never been refuted—that averages represent, as a rule, conditions which have no existence whatever. Thus, for example, the number of individuals who are incapacitated for work by ill-health for just nine days every year, no more and no less, must be extremely small. However, we may let this pass. If we take the year to consist of 300 working days, it will be seen that about one thirty-third of the total working time is lost in the way Sir James Paget indicates. He himself calls the loss one-fortieth. If we take a week's work at 56 hours, we have for 50 weeks 2800 hours, and 85 hours is the thirty-third of this. Consequently, by working 1 hour 42 min. longer than 56 hours every week, the entire loss to the nation would be recouped; and adopting Sir James Paget's method, we might show that because men work only 56 hours instead of 57¾ hours every week, the nation loses £11,000,000 per annum. Pushing the argument a little further, we might prove that the loss incurred by the nation because people sleep seven hours every night instead of six is almost incalculable. These are legitimate deductions from Sir James Paget's figures. It will, no doubt, be pointed out that sickness is a different thing from voluntary abstention from work. Of course it is; and because it is, we assert that it ought to be dealt with on a totally different basis from that adopted by Sir James Paget. No doubt his object is to convert the working classes—the manual workers—to the true sanitary faith; but to urge on them, as a body, that the great point to be gained by being well is ability to labour will not touch them at all. It will not convert them; it will do just the reverse. They know, what Sir James Paget apparently little heeds, that the labour market is so overstocked that the loss of nine days' work to a man is but as a drop in the ocean. If sickness ceased to exist, the whole working population would be virtually increased in number by one-thirty-third, and this would be immediately followed by a fall in wages to at least the same extent. This is just what the wages' earners do not want. Sir James apparently forgets the case—to cite one among several—of the Redditch needle grinders. Years ago needle grinding was one of the most unhealthy trades in existence, and one of the most highly paid. A needle grinder more than forty years old was looked upon as a curiosity—someone to dispute honours with Old Parr. The men died of lung disease brought on by inhaling grindstone dust and steel. An attempt was made to introduce magnetic respirators, which was a total failure—the men would not use them. Then fans were put up to draw away the dust—the result was a strike. The needle grinders, as a body, saw that if the business was rendered healthy, wages would fall and the number of workers would multiply. It took years to combat the difficulty successfully; the men were beaten in the end. Our colliers at this moment refuse to work full time, and the general tendency, the whole spirit, of the age is to reduce the number of working hours in the year. To tell men who have to work that if they will only give up beer, and ventilate their homes, and look to their drains, and drink less tea, and vaccinate their children, they will be able to work longer hours, is to hold out to them anything but the proper inducement to preserve health.

A similar fallacy runs through other arguments used by Sir James Paget. For example, speaking of the deaths of children, he said, "it may justly be said that all that they have cost during their lives is so much money sunk; so much capital invested and lost. If they had lived to work, their earnings would have been more than sufficient to repay it; but they have died, and their cost is gone without return. The mortality of children under 15 in 1882 was nearly a quarter of a million; what have they cost? If you say only £8 apiece, there are more than £2,000,000 sterling thus lost every year." Now against this we may point out that it would not be at all difficult to show that the loss of each child is a direct pecuniary gain. Take, for example, a child which dies at five years old, and has cost, say, £8—Sir James Paget's estimate is absurdly low—if the child lived five years longer, its cost would have been, say, £20. Thus by its death in comparative infancy, £12 would have been saved. Pushing the matter further, let us suppose that each child died at a month old, when it had cost say, £1. Then a direct saving of £7 would have been effected, or nearly £2,000,000 for the nation, on Sir James Paget's basis of argument. It is only necessary to state the case in this way to show how meaningless, to say the least, his argument is. The value of children's lives is not an affair of pounds, shillings, and pence, and it will be an evil day for the nation when it begins to regard the worth of the rising generation on such a basis. The children of a people possess an inestimable value. They are the hope of the nation. It is to them that we look for progress. It is the little ones who must be taught and led in the right path. To estimate their value in terms of what they cost is simply fatuous. It has no meaning to anyone who has grasped the very rudiments of political economy, and we feel certain that Sir James Paget will see this point in its true light on reflection. He permitted himself to be carried away by the charms of an ingenious argument, the hollowness of which escaped his notice for the moment.

So far we have dealt only with Sir James Paget's views concerning those who work with their hands. His reasoning is yet more deceptive if we apply it to the brain workers, who, he tells us, lose 9,000,000 weeks' work in the year through sickness. This argument can only be true on the assumption either that poets, painters, lawyers, &c., work continuously, or that they are always taken ill just when they would have worked if things had been otherwise. We do not think we need stop to point out that poets, for example, are not writing poetry all day long and day after day—at least it is to be hoped not. Musicians are not always composing; and even philosophers unbend sometimes. To talk of sickness interfering with the work of such men now and then is quite correct; to assume that it prevents them from doing 9,000,000 of weeks' work per annum is to assume too much.

The true argument in favour of the adoption of every possible means for maintaining the health of a nation is that health promotes happiness. It is impossible to estimate happiness in terms of pounds, shillings, and pence; but it may be said without fear of contradiction that the healthiest nation will be, on the whole, and other things—in the shape of good government, just laws, and such like—being equal, the happiest nation; and any attempt to reduce the value of health to a pecuniary standard is idle. In sickness we are prepared to sacrifice our worldly goods to be restored to health; and the man who lies on a sick bed will hardly be disposed to accept Sir James Paget's estimate of the loss incurred as sufficient. It is impossible to refrain from admiring much that Sir James said; but it is equally difficult to avoid an expression of regret that he did not take much higher ground than he did.

COLONEL HOPE AND HIS GUNS.

WE have been favoured with a letter from Colonel Hope on the subject of "National Defences." Colonel Hope laments the apathy with which our rulers receive the alarmingly unfavourable verdict given by Sir Thos. Symonds, Sir John Hay, and Lord A. Lennox on the state of our Navy, and the dependence of parliamentary chiefs on the judgment of their permanent managers who, though smart and clever of their kind, ought not to be depended on in this way. He states that the 100-ton gun at Gibraltar has been put *hors de combat* and practically rendered of no use—that the "Ordnance Department's" only success has been in the number and costliness of its failures. In old days, he urges, the guns made by the Lowmoor and Carron companies did their work well and needed no excuses to be made for them; 2000 rounds were safely fired from such guns, whereas now the life of a gun is 400 rounds, the piece being carefully examined every 50 rounds. He considers that three millions of money were spent on the introduction of the Armstrong breech-loading system, which provided only weak and faulty guns now obsolete and half worn out—that the "Campbell-Fraser modification of the Armstrong gun," which was pirated from Lynall Thomas, was even a worse affair, and that the Ordnance Department's guns were all bad, and many of the statements in the official text book "wrong, erroneous," and "untrue." In support of these strong statements, a petition, signed by Sir H. Bessemer, Mr. Merrifield, and Professor Osborne Reynolds is quoted, urging that the defects in our present system of ordnance arise from the absence of independent criticism, and from the technical advisers of the Government being the men who are responsible for the existing faults; that systems of ordnance superior to that known as the Woolwich system have not had a fair trial, and that false information and wrong principles have been officially disseminated in both services. Colonel Hope adds that in 1880 he made a "no cure, no pay" offer to the Ordnance Department—for "the Navy is now subordinated to the Ordnance Department"—showing a saving of 80 per cent. in weight and 60 per cent. in money on the Woolwich guns, implying an increase of 400 per cent. in power, weight for weight, which offer was wholly neglected till repeated through Lord Wolseley.

The offer was to make, (1) a 7-ton gun, 18ft. long, developing more energy per inch circumference than the 38-ton service gun; (2) a 17-ton gun, 23ft. 6in. long, to develope more energy per inch circumference than the 80-ton "Woolwich" gun; and (3) a 30-ton gun 29ft. long, developing over 1000 foot-tons energy per inch circumference, which is in excess of anything yet attained. The prices were about £1550 for No. 1, £3800 for No. 2, and £7900 for No. 3. The proof was to be ten rounds per gun with solid shot 5 calibres long, without gas escape, and cartridges of powder not less than 15 calibres long, all converted into gas within the gun. The ammunition and guns not to be paid for unless they passed the tests. For endurance, a Hope gun was to be placed alongside the particular Woolwich gun it undertook to beat and fired 12 rounds per hour until the Woolwich gun burst, the Hope gun to fire 100 rounds more and then to be still serviceable. Lord Wolseley to be the sole arbitrator. Following this letter was some correspondence, in which the Director of Artillery declined Colonel Hope's proposals, but offered to try any gun he liked to offer on the usual conditions at his own expense, but without the Government committing themselves to Colonel Hope. Colonel Hope considers that this is not a business-like offer, and suggests that if the Ordnance Department will say plainly that they do not mean to supply any guns to the Navy except those made at Woolwich, he will trouble them no further, but as long as other issues are raised he shall deal with them.

This is not a pleasant story to relate. We have given it briefly, but we trust fairly. We wish that not only Colonel Hope but some others could have better opportunities of having their proposals tried. Nevertheless, we are bound in fairness to say that, striking as the above offer may appear on the face of it, it is not a proposal that could be accepted. We are urging nothing against it, be it understood, except the imperfection of the terms as they stand. Colonel Hope altogether omits to mention the calibres of his gun, he takes the *work per inch circumference* as the standard, but this will not do, and tells very little unless the circumference itself be given. It is true, no doubt, that theoretically this is a measure of the thickness of iron that a shot will perforate; but even so it could hardly be admitted that the size of the hole made was wholly a matter of indifference. To take an extreme case—if two guns of the same external dimensions were bored, one to 12in. diameter and the other to 4in., it is obvious that if the latter be made to develope greater work on each of its 12in. circumference than the former had on each of its 36in., on Colonel Hope's standard it would beat it, although it might have hardly more than one-third part of its total energy. As we have pointed out repeatedly, perforation is fast going out with soft armour. Really hard armour must be shattered, and the measure of the power to do this is total energy, not energy per inch circumference. Krupp's standard of a gun's achievements is the total energy in the projectile per ton of gun. This is fair enough. In Germany the shock on a plate is taken as striking energy per ton of plate. We do not say how Colonel Hope's guns stand as to total energy, for we are not told by him. Of course the length of his cartridge suggests a very small bore, which would argue a curious result rather than one of any great practical value. Perhaps, however, Colonel Hope can tell us how his guns stand on the acknowledged standard to which we refer. Much as we wish to see guns tried, any wise man would decline to take up a blindfold challenge, and commit the country to what might be grossly wrong. After the remarks on theoretical soundness, we should expect to be told something sound and substantial. Mere velocity, for example, alone would be worth little. Over 3000ft. velocity has been repeatedly achieved, but with a very light projectile, whose weight is the explanation of the feat. Energy per ton of gun, combined with maximum pressure in the bore, is the soundest concise standard that we know of. Again, Colonel Hope might naturally shrink from trying a gun without any promise of encouragement given of success; but surely he would have an unanswerable case before the public if he obtained very much greater energy per ton of gun at a given pressure. Nay, we have been told that Colonel Hope has had some trials made by the French Government. If these results are made public we can judge of the power of the guns. We shall be very happy to give such results to our readers; indeed, we have made inquiry on the subject before now. We should certainly be glad to see inventors encouraged by definite promises on obtaining substantial results. If Colonel Hope can do what he undertakes he ought to be met fairly and assisted liberally. The offer he makes in its present shape may suggest a very small bore in a comparatively heavy block of metal. Such a gun would have a chase of great length, in proportion to its calibre; it might develope a very high velocity, and the strain on it, even at a high pressure, would be small, because it would act on a very small surface. Such a gun would compete for endurance on such unfair terms that it would be no competition at all. Its shot might perforate a considerable thickness of wrought iron, but its total energy would be small, and its effect against steel or chilled iron armour would be insignificant, and common shell or shrapnel from such a gun would be contemptible. Colonel Hope must see that such a piece might be produced, and can remove our impression by giving the total energy per ton of gun his system of ordnance can develope, or still better, has developed in the recent French trials. In a matter such as this nothing is more important than the result of an actual experiment.

BOILER EXPLOSIONS.

We have lying before us the report of Mr. Henry Hiller, chief engineer to the National Boiler Insurance Company, St. Ann's-street, Manchester. It is a well-written octavo pamphlet of fifty-eight pages. The story Mr. Hiller has to tell is old; we have the usual record of ignorance and neglect, resulting in disaster. Very little progress seems to be made toward the day when boiler explosions will be heard of no more. "Some parties," writes Mr. Hiller, "appear to imagine that boilers may be left to take care of themselves, and thus adopt no effective measures to ascertain their actual condition by thorough inspection—a mistaken confidence which is liable under such circumstances to be at any time dissipated by disastrous explosion. Such persons apparently forget that owners or managers, as well as workpeople, are often included amongst the victims of boiler explosions. In some of the mining districts especially, we have met with boilers in most disgraceful and dangerous condition; and many explosions have occurred through the generally deteriorated condition of the boilers, which were attributed by those responsible to causes which in no way contributed thereto."

It is not necessary to go to the mining districts for examples of neglect. They may be found in the heart of Manchester, of London, of Liverpool, of all manufacturing centres. The causes which bring them about scarcely seem to be quite understood by boiler insurance companies and their engineers. Mr. Hiller and his professional brethren are indignant that lives should be lost and property wasted year after year by strictly preventible boiler explosions. This is quite natural. We could wish, however, that they dived a little below the surface and set themselves the task of discovering the reasons why boilers are not properly inspected and cared for. Before they can be removed, or fairly combatted, their nature must be ascertained. Not one cause or a dozen induces neglect of sufficiently obvious precautions. They vary in different districts, and with different trades and individuals. One, however, appears to us to continually present itself, and this is want of faith in the operations of the boiler inspector. Thus, for example, two firms may carry on their business side by side; the one insures its boilers; the other does not. Yet years elapse and no explosions take place; apparently no advantage of any kind has been gained by inspection, while a great deal of so-called unnecessary trouble has been incurred. Unfortunately, or fortunately, a boiler will stand a great deal before it bursts; we have only to read over such a report as this before us to see how much; and men are slow to believe that a small crack or a little corrosion can really be such a serious matter as the inspector tells them it is. If, on the other hand, the percentage of disastrous boiler explosions was much larger than it is, then insurance and inspection would be much more resorted to than they are. Again, even of the explosions that do occur, only a percentage could have been avoided by inspection pure and simple. Mr. Hiller tells us that he has received reports of forty-two explosions which occurred in the United Kingdom in 1883, by which twenty-two persons were killed and fifty-seven severely injured. This does not include kitchen boilers. Since the establishment of the National Boiler Insurance Company in July, 1864, he has had reports of 945 explosions, by which 1092 persons were killed and about 1820 injured. Now when we come to analyse these figures, we find that 264 arose from defective condition, 213 from congenital malconstruction, the boilers being bad even when new; 71 were due, according to Mr. Hiller, to the boilers being externally fired; while no fewer than 250 were the results of neglect on the part of attendants or of mismanagement of some kind. It will be seen that of the total only 264, or little more than one-fourth, could have been avoided by the most careful inspection. Of these explosions 141 were due to external and 47 to internal corrosion, 44 to general deterioration, 27 to internal grooving, and 7 to defective stays. Of the 250 due to neglect or mismanagement, over-pressure accounts for 104, shortness of water for 123, overheating through deposit for 21, and overheating through defective flues for 2. With these 250 it is difficult, if not impossible, to see how any insurance company can grapple. The world of steam users is not slow to understand this, and it has often been urged to us that inspection is not half as good as it looks, because boilers explode from causes with which the question of inspection or non-inspection has nothing to do. We have here, we think, one of the prominent reasons why all boilers are not insured, or at least inspected.

To make the system more generally useful, we hold that the scope of inspection and insurance should be enlarged, and that certain rules now in force should be altered or withdrawn altogether. The insurance companies would very willingly take action in the direction we are about to indicate, but for two reasons. The first is the unpopularity of boiler insurance, or more strictly, of inspection; and secondly, the keen competition which exists among rival companies. This prevents them from dealing with their clients with due firmness. Under existing conditions the companies always pay for collapsed flues, no matter how the collapse is brought about; and this constitutes the principal charge on the funds of the insuring companies. The sum disbursed as a result of explosions is extremely small; that paid for collapsed flues is very large. These collapses hardly ever appear in the reports of the engineers; the knowledge of them is confined to the insured and insurers. Thus a pair of furnace crowns in a Lancashire boiler come down, no one is hurt, and no other mischief is done. The old plates are cut out and new plates put in at the expense of the insuring company. In ninety-nine cases out of a hundred the collapse is due to shortness of water, and that is due in turn to the fireman, and may, if we continue the trace, be finally brought home to the nearest beershop. If insuring companies absolutely declined to pay for flues collapsed by shortness of water, the direct result would be that a much better class of firemen would be employed. The present system holds out a premium for the employment of inefficient men. The insurance companies assert, however, that they dare not make a change in the direction we indicate, for if they did they would get no business; and that this argument has a foundation in fact is proved by the circumstance that while about 50,000 boilers are inspected by various insurance companies, the Manchester Steam Users' Association has only about 4600 boilers on its books—a result mainly attributable to the extreme caution exercised in accepting boilers. As regards malconstruction, the engineers to all the insurance and assurance companies willingly advise their clients. But so long as low-priced boilers are sought for and bought, so long will bad boilers be used. No one who has not had personal experience can imagine how bad some boilers are. Were we to mention cases which have come under our own knowledge they would hardly be believed. Here is a case cited by Mr. Hiller—What do our readers think of it? A vertical boiler, with internal fire-box, height about 7ft. 8in., diameter 4ft. 3in., exploded. On examining the boiler after explosion, the rivetting of the bottom ring seam, uniting the shell and the fire-box, was found to be very defective. When these were put together the holes had evidently not corresponded, and a second set of holes had been punched, the punchings being used to fill up the spaces of the original holes; the result being that the metal between each hole was little more than $\frac{1}{4}$in., and even less in some places; and this must have been severely strained, if not entirely fractured, by the punching and subsequent treatment. The rent occurred at the line of rivets referred to, and extended in various directions through the solid plate of the shell, which was torn to pieces. The surrounding property was damaged, and two men injured. We quite agree with Mr. Hiller, that "this was a gross case, and deserved criminal punishment." The difficulty is to devise means by which it may be inflicted when it is deserved. We have said that the causes which induce neglect of obvious precautions vary with circumstances and individuals. As an illustration of the truth of this, we may call attention to the fact that while there occurred in the United States last year 184 explosions by which about 300 persons were killed, no fewer than 74 of them, or about 40 per cent., took place in saw mills, and carelessness and ignorance were the principal causes. What is the connection between saw mills and boiler explosions we are not prepared to say.

Mr. Hiller comments somewhat sharply on the attempts which have been made by Mr. Fletcher to underrate the value of insurance. Mr. Hiller does not name Mr. Fletcher, but it is an open secret that he is meant. In this matter, as in all others, the truth lies between extremes. So long as the insurance companies carried on their operations, without attempting to secure business on ruinous terms, nothing was to be said in favour of Mr. Fletcher's arguments. But as we have already pointed out, the case is altered as soon as it can be shown that the insurance system is attended by the employment of incompetent firemen or risky feeding arrangements. The practice of making good damage to flues and furnaces, brought about by drink, or ignorance, or negligence, cannot be too much deprecated; and Mr. Hiller will have to show a much better case than has yet been brought before us before we can regard that practice as in any sense or way desirable. If it is definitely stated that it must be done, then there is, of course, an end of the matter. If, however, all the insurance companies would combine on this point, and declare that they would not pay for short water defects, what would be the result? We shall not attempt to give an answer, for a great deal would depend on the new conditions established. Thus, for example, if companies can insure and repair furnaces and make a profit, they ought to be able to take a reduced premium under the new *régime*. Anything which can contribute directly or indirectly to the employment of incompetent men ought to be avoided. But human nature is strong; and so long as a steam user knows that the repair of his furnaces will cost him nothing, any one who can throw coals on a fire he will be apt to regard as a stoker good enough for his purposes. As to the results to be expected from legislation in the matter of boiler explosions, we confess we are extremely doubtful. We have no doubt, however, that a good and useful Act of Parliament might be passed; but we do not think that the Government have got the proper men to administer it. The "Boiler Explosions Act" has been in force since July, 1882, the only result being, so far as we can see, the production of a number of more or less silly reports prepared by officials of the Board of Trade, who have had no previous experience or special training in the work they have to perform. Possibly they may improve in time. We should be sorry, however, to see the Board of Trade entrusted at present with power to deal with the steam boilers of the United Kingdom.

A CURIOSITY IN PATENTS.

It is well known that in theory, at all events, only one invention can be covered by a patent in the United States. On the 1st of February in the present year Mr. C. A. Mayrhofer, of Vienna, took out an United States' patent, No. 299,663, for "mechanism for automatically casting and recording ballots actuated by the pressure or expansion of a fluid." The specification is a reasonably lengthy document, but the curious part of the affair is that while there are no fewer than sixty-four separate claims, many of them long and complex, Mr. Mayrhofer has obviously succeeded in satisfying the authorities that they cover only one invention. This is certainly a triumph of specification drawing, and reflects the greatest credit on the inventor's agent. When, however, we attempt to contemplate the results which would follow on litigation we stand appalled. We reproduce a couple of the claims taken at haphazard. Claim 12 runs: "In a system of balloting, the combination, with mechanism whereby a ballot is cast or delivered from a holder, mechanism whereby a permanent record of the delivered ballot is simultaneously produced, both operated by the pressure or expansion of a fluid, and a suitable distributing pipe and main connected together and with said mechanism, of a valve interposed in the main and distributing pipe or pipes, whereby communication between the two is established or cut off and the fluid exhausted from the distributing pipe, for the purposes described." Claim 13 is: "In a balloting system, the combination of mechanism whereby a ballot is cast or delivered from a holder, mechanism whereby a permanent record of the delivered ballot is simultaneously produced, appliances for operating said mechanisms by the pressure or expansion of a fluid, a suitable fluid distributing pipe or pipes and main, and mechanism actuated by the delivered ballot, whereby said ballot is counted, with a valve interposed in said main and distributing pipe, whereby the fluid is admitted to the distributing pipe from the main to actuate the ballot-delivering and permanent-record-producing mechanisms, whereby a ballot is delivered from its holder, a permanent record thereof made, and the ballot counted simultaneously, for the purposes specified." The success of the inventor in obtaining a patent with so many claims in the specification could not be achieved without a system, and the claims we have quoted supply a clue to the system. It is nearly identical with that on which the celebrated idyl, "This is the house that Jack built," was constructed, and may be applied to a steam engine, for example, in the following way: "I claim this engine that I invented; I claim this cylinder of this engine that I invented; I claim this piston that works in the cylinder of this engine that I invented; I claim this piston rod that is fixed in this piston that works in this cylinder of this engine that I invented; I claim this crosshead that is keyed on this piston rod that is fixed in this piston that works in this cylinder of this engine that I have invented," and so on. We imagine that something must be gained by sending in a multitude of claims. Such a specification as that of Mr. Mayrhofer is, indeed, enough to frighten a staff of examiners out of their wits.

IRON AND STEEL RAILS.

THE condition of the iron and steel rail trade does not seem to be very prosperous so far as the export branch is concerned. In the past five months of the year the total quantity of iron rails exported was 6035 tons—less than one half of the quantity for the corresponding half of the past year, and only a fifth part of the quantity for the first five months of the preceding year. It must, then, be acknowledged that the iron rail trade has almost completely collapsed. So far this year, none have been sent to Germany, Holland, Italy, the United States, or Mexico, and the British East Indies seems the only place that retains the little trade of last year. The steel rail trade also shows a considerable falling off. During the five months of the present year the quantity of steel rails exported was 236,184 tons, or about 76,000 tons less than that exported in the corresponding period of the past year. In the current year none have been sent to Holland, but we retain a trade with all the other countries that are specifically enumerated in the official list. In the present year Australasia has been our largest buyer of rails; and to the East Indies we have sent so far little more than half of the quantity we sent in the corresponding half of the past year. The falling off in the demand from the United States is the most remarkable feature in the return. There have been satisfactory increases in the quantity sent to Chili, Peru, and some of the smaller buyers; but the increase in the exports to Sweden and Norway have been much larger. On the whole, the export rail trade so far this year shows a fall from 326,864 tons to 242,219 tons for the five months, with a decline in the value that is perhaps even more than corresponding. The satisfactory feature in the return is that we are shipping our rails over a wider area than we used to do, and to that extent we are improving prospects. To the British East Indies we are not sending the large quantity that we ought to send, and it is well worth the attention of our rail-makers to consider why this is the case. There ought to be an enormous trade with the East in rails, if dependence is to be placed on the statements that have of late appeared as to the needs of India. At the same time the rumour that rails for that country have been in quest on the Continent is one that needs investigation. We ought at least to be able to retain the whole of the supply of our colonies with rails in our own hands, and the rail-makers would do well to see that they do so.

LITERATURE.

A Practical Treatise on Electric Lighting. By J. E. H. GORDON, B.A., M.S.T.E. Sampson Low, Marston, Searle, and Rivington, London. 1884.

THE first worker in metals is a man of historic interest, but the position of Tubal-Cain was widely different from that of his descendants of to-day. Before the age of printing men had to depend for their knowledge principally upon their own experience and the experience of those with whom they came personally into contact. To-day the accumulated experience of hundreds, if not thousands, can be placed in the hands of every student. Improvements suggested in America to-day are known all over Europe to-morrow, and the improvements initiated in Europe are similarly known in America. This almost instantaneous dissemination of knowledge by means of technical journals leads to a corresponding rapid progress in any application of science; hence the strides made in a few years as regards electric lighting. The votaries of applied science are Argus-eyed, and by its means the wealth of nations is increased. Thus every experience is rapidly seized and, if possible, utilised. Electric lighting affords an excellent example of this fact; its progress has been marvellously rapid. Mr. Gordon has for the first time placed in a concentrated form the accumulated experience of electric light engineers during the past six years. It may be that the author has not attempted to enter into all the details, the discussion of which is desirable; but the reason may be that there still exists such an utter lack of agreement as to some methods, that the further experience gained by discussion in such a form might be misleading. A correction cannot easily be made in a book, though it may be in a periodical; hence we agree with the author, for example, about central station lighting, that it is better to wait for more information than to attempt a description now.

It seems to us that the author of such a book as this should treat his subject under heads, his principal heads being—(1) generation; (2) distribution; (3) utilisation; and (4) tools; the sub-heads may be as numerous as the author chooses. With regard to the generation of electricity little need be said of batteries; but some attempt might be made to explain the great similarity of the various dynamo machines. They are easily classed under a few types. The continuous ring armature type includes such as the Gramme, Bürgin, Brush, Schuckurt, &c. Then we have the Siemens armature type, alternate current machines, and so on. Starting with a full and complete description of the typical machine, the various modifications, the reasons for their introduction and the gains by introduction could then be successively discussed. However, it is generally admitted that, according to their own showing, most reviewers would make admirable authors. Unfortunately, when they attempt to carry into practice the views they put forward, the result is frequently a miserable failure. We shall therefore return to the real subject of this notice, showing that Mr. Gordon has, to some extent, carried out these views. After an introductory chapter on the principles of artificial lighting, he shows the analogy between a fluid, such as water, and electricity. Although we think the way in which Mr. Gordon has introduced these analogies to be exceedingly instructive, we must not forget the caution of Clerk-Maxwell when warning his readers against the use of the term "electric fluid." He said: "It is one of those phrases, which, having been at one time used to denote an observed fact, was immediately taken up by the public to connote a whole system of imaginary knowledge. As long as we do not know whether positive electricity, or negative, or both, should be called a substance or the absence of a substance, and as long as we do not know whether the velocity of an electric current is to be measured by hundreds of thousands of miles in a second, or by a hundredth of an inch in an hour, or even whether the current flows from positive to negative or in the reverse direction, we must avoid speaking of the electric fluid."

The aim of those who desire to produce artificial light economically is thus stated, p. 8, "to concentrate the heat in a solid of the smallest possible size, or with the smallest possible cooling surface." How this is done in electric light operations it is the business of the book to show. Whenever a new application of science is developed, it becomes necessary to show how the principles of the science are used in the development. Practical work needs systems for measurement, practical units of measurement, notation, and so on—a branch of the subject to which Mr. Gordon devotes some of the early chapters of his book. In these he discusses the relation of the electrical units with one another, and with the units of heat and work. The electrician finds nothing new herein, but the electrical engineer will here see the arithmetic of his work. The formulæ he has to use are collected and illustrated. Here, too, are some interesting comparisons, showing the value of the commercial electrical unit in various measures, and we are given a rule for the comparison of the prices of electricity and gas. Thus: "To compare the price of electricity with that of gas, we must multiply the price per electrical unit by 10, and the result will be the price of a quantity of electricity approximately equal in illuminating power to 1000 cubic feet of gas."

It is altogether a mistake to suppose that recent experience has found out anything new in the method of distributing lamps. Patent-office seekers seem to think that they have found out unique methods of distribution, and use terms such as series, multiple arc, &c., as if they were of recent origin. So far as we know, there cannot be any new method of arrangement of lamps. They must be in series or multiple arc, or a combination of the two. The calculations, however, of horse-power lost or utilised are new introductions, inasmuch as in telegraphy the currents used are feeble compared with those used in electric light operations. The loss of electricity in mains through leakage is a question of the utmost importance to the electrical engineer; and Mr. Gordon has done good service in giving an elementary demonstration of the calculations required under given conditions. The dimensions of conductors to carry given currents under given conditions is another important question discussed.

The papers of Sir W. Thomson, Professor G. Forbes, Mr. Beckersley, and others on these subjects should be read with the remarks of Mr. Gordon. In this part of the work several forms of instruments used in the measurement of currents are described.

Electricity—to use an ordinary expression—generated for electric light purposes is utilised by means of lamps. These lamps belong to one or other of two systems, viz., arc or incandescent. In the early days of electric lighting the latter were not much supported even by the most eminent electricians; but opinions have changed, and it is now understood that the incandescent lamps offer the readiest and best solution to the problem of general internal lighting; while the arc lamps are more suited for large spaces and special purposes. The arc lamp undoubtedly at present comes nearest to the theoretic ideal—the raising of the body producing the light to the highest possible temperature; for while it is possible to raise incandescent lamps to a high temperature, it is not judicious, as the life of the lamp is then reduced to a minimum. The different incandescent lamps are, in the first place, described, and their method of manufacture, the details being given and amply illustrated. Then the best known types of arc lamps are described. The requirements for the lighting of particular places are discussed, and it is shown how the lamps and other apparatus must be designed for the purpose in view. A paragraph or two will best show the author's method—thus, p. 85, "In lamps intended for street lighting the chief consideration is steadiness and freedom from flickering. They must be moderately cheap, and not too heavy to hang on an ordinary lamp-post. A temporary extinction of the light, though much to be deprecated, would not, as in the case of lighthouse lamps, be likely to have consequences fatal to life, and therefore strength of machinery need not be studied to the exclusion of all considerations of economy." A very interesting chapter, for which the author states his indebtedness to Mr. Crompton, on carbons for arc lamps, is given, and then we come to that portion of the book dealing more directly with the generation of the current. Besides being a writer, Mr. Gordon is an inventor, and professes to follow the example of Cumberland, Maskeylene, and others in "telling how it is done." We doubt, however, if the readers can invent, after reading this book, any more than the hearer could perform the tricks shown at St. James's Hall after hearing how they were done. Indeed, the telling is simply reduced to this: Mr. Gordon has by a process of reasoning come to the conclusion that a certain type of dynamo is the best, and he forthwith sets to work and designs such a dynamo. Now we are inclined to think that there is more than one road to travel in order to get to a new design of dynamo; and we are not at all sure that Mr. Gordon's explanation proves that his road is the best. However, there is no doubt that he puts forth the principles of magnetic induction and of the best-known machines in a clear and concise manner. All this part of the book is exceptionally worthy of close study. It abounds with hints of a very practical nature, and points out what not to do in many cases. The poor mathematician is very decidedly snubbed, as are the designers of some be-puffed machines. "The mathematician is of too transcendental a character, considering the result complete if he produces a formula connecting the quantity whose value is required with four or five constants, whose value he assumes to be known when he has indicated them by the earlier letters of the alphabet." This is hardly what we should have expected from a pupil of Clerk-Maxwell; but it may be that the posthumous work of the master has convinced the pupil that the ways of Faraday are the best. Let us be careful not to run to the other extreme. The mathematician is useful, nay, is necessary, and his work is hardly to be laughed at. Professor Tait states that Maxwell put 'electricity' upon a somewhat similar footing to 'light.' Non-mathematicians may understand a good deal, but to reason out more completely requires all the knowledge that mathematicians can bring to bear upon the subject. Mr. Gordon, again, has little favourable to say with regard to secondary batteries, but he does say that 'there is one form in which the proposed use of secondary batteries will deserve consideration when a practical secondary battery shall have been constructed. It has been proposed that the engines and dynamos shall be placed outside the town to be lighted, and that the batteries shall be kept in the centre of the town. It is then proposed that a high-pressure current shall be brought from the dynamos to the batteries by the use of fine wire, a great number of the batteries being arranged in 'series' to receive the charge, and then altered to a 'quantity' arrangement to discharge to the lamps." What Mr. Gordon has thus described has been carried out at Colchester at a saving, it is said, of some £3000 in copper mains. There they have five battery stations, and charge with a high-pressure current as described. The only question raised by the Colchester installation is whether the battery used is a "practical secondary battery." Experience alone will show this. The work concludes with an appendix containing useful tables and an index.

We have thus briefly called attention to a book which contains a large amount of information—information, too, which is of a very practical nature. Many men after reading this book will probably modify their views upon certain subjects; and it is no less certain that the author will have to modify his views upon certain subjects. He has learnt much from experience, and has freely given the information to his readers. Further experience is needed to certify some of his conclusions; and we have no doubt that the large installations at Paddington, at Victoria, at Colchester, and elsewhere, studied in the light that is now given to us, will add much to the stores of learning of the electrical engineer. It may be that secondary batteries are of little use—it may be that the Gaulard-Gibbs system is imperfect—that the Ferranti machine is not a good one, and so on. These are misfortunes; but every day is helping us to satisfy our curiosity on these and other moot points, and it may be that, like the incandescent lamp, the thing that is looked upon with suspicion to-day will prove of service to-morrow.

Before concluding this notice a word of praise should be given for the excellent illustrations and typography of the book.

BOOKS RECEIVED.

Iron Roofs. Examples of Design. Description, illustrated with Working Drawings. By A. T. Walmisley, A.M.I.C.E. London: E. and F. N. Spon. 1884.

Report of the British and Naval Military Operations in Egypt, 1882. By Lieut. Commander Caspar F. Goodrich, U.S.N. Parts 1 and 2. Text and plates. Washington: Bureau of Navigation. 1883.

A Manual of Rules, Tables, and Data for Mechanical Engineers. By Daniel Kinnear Clark. Third edition. London: Blackie and Sons. 1884.

A Treatise on Chemistry. By H. E. Roscoe, F.R.S., and C. Schorlemmer, F.R.S. Vol. VII. *The Chemistry of Hydrocarbons and their Derivatives, or Organic Chemistry.* Part II. London: Macmillan and Co. 1884.

Tin: Describing the Chief Methods of Mining, Dressing, and Smelting it Abroad. By A. G. Charleton. London: E. and F. N. Spon. 1884.

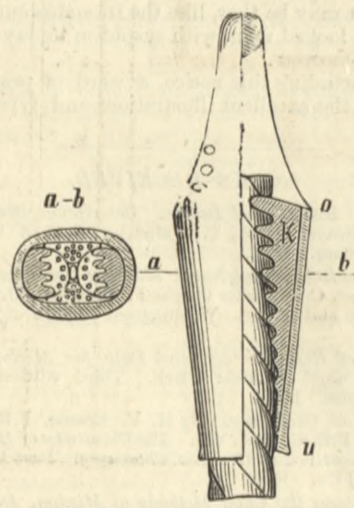
A Handbook of Electrical Testing. By H. R. Kempe, M.S.T.E. Third edition. London: E. and F. N. Spon. 1884.

THE STAFFORDSHIRE EXHIBITION.—In the report of this exhibition which appeared in our last week's issue, the address of Messrs. Miller and Co., who show chilled wheels and other manufactures, should have been London-road Foundry, Edinburgh, not Leeds.

DUPLEXING OF THE MACKAY-BENNETT ATLANTIC CABLES.—At the Royal Society's *conversazione* on the 11th inst. a very interesting exhibit was made by Messrs. Latimer Clark, Muirhead, and Co., of the electrical apparatus manufactured by them for the Mackay-Bennett Atlantic cables, consisting of Muirhead's condensers and inductive resistances, exhibited in operation to illustrate their system of duplex telegraphy as applied to submarine cables, an artificial submarine cable formed of Muirhead's inductive resistances of the same electrical dimensions as the cable now being laid by the s.s. Faraday, working duplex with Sir William Thomson's syphon recorders, one at each end of the line. The artificial cable has the same ratio of resistance to capacity throughout its entire length as the real cable of which it is an electrical *fac simile.* The total capacity of the apparatus employed in this exhibit was 2220 microfarads, equal to that of about 6700 knots of submarine telegraph cable. Such a display of apparatus is specially interesting, representing as it does the fruits of much labour and experience, and a large outlay of capital. Those engaged in submarine telegraph work can appreciate the practical advantages of such a system as that which practically doubles the carrying capacity of the cable.

THE CRYSTAL PALACE EXHIBITION.

In the Crystal Palace there is at the present time a collection of articles forming an exhibition of no one particular denomination. There is some machinery, including one or two portable and fixed engines, light railways, food preparing machines, a middlings purifier, a centrifugal flour-dresser, a few pumps, and so on; and there are some illustrations of forging in iron, steel, and Delta metal, a Delta metal launch, and a lot of sundries. This part of the exhibition is not attractive, but in the other part there is plenty of very beautiful porcelain and glass work and other articles of general interest. Messrs. Robey and Co. show four of their well-known engines of different types, and a thrashing machine, which somehow seems ludicrously out of place in the miscellaneous collection which makes the "filling in" of the Crystal Palace show. Some flour mill machinery by Messrs. Feldtman and Co., of London, seems equally out of its element. One of these machines is a middlings purifier with suction blast, and the shaking sieves supported by wood spring bars like inverted spring hangers. Another is Kahl's centrifugal, in which it is claimed that a No. 11 or 12 silk gauze may be employed, whereas in other machines a No. 13, 14, or 15 is required. The beaters are arranged so that the flour is not driven directly through the silk. Two sets of beaters are used, one set being of such a form that they turn the meal away from the silk and throw it towards the centre, by which an extra disintegrating action is effected, and it is only the current of air produced by the outer beaters which causes the flour particles to pass through the meshes of the silk. A more gentle action is thus produced, but it is said that, owing to the larger particles and branny material being constantly returned to the centre, and thus leaving the gauze free for the passage of the flour, and the effect is a high-class flour, and the capacity of the machine is at least as great as that of any other of the same size, while the wear on the silk gauze is much less. The same firm shows one of Kahl's—Hamburg—corrugated roller mills, fitted with automatic disengaging gear, by which the rollers are allowed to separate under the influence of springs when the feed runs short. A side view diagram of this machine is given in the engraving below. To set the rollers parallel, a piece of paper is passed on each end between the rollers, and the screws H adjusted, until the impression of the roller corrugations on the paper are exactly the same on each side of the rolls. The pressure is applied by means of lever D, which is in connection with both bearings of the movable roll by means of the shaft and lever F. The distance of the rollers is also adjusted by means of lever D, and once set they will remain parallel. If the roller mill is properly adjusted, the adjustment of the distance of the rolls is performed by means of lever D

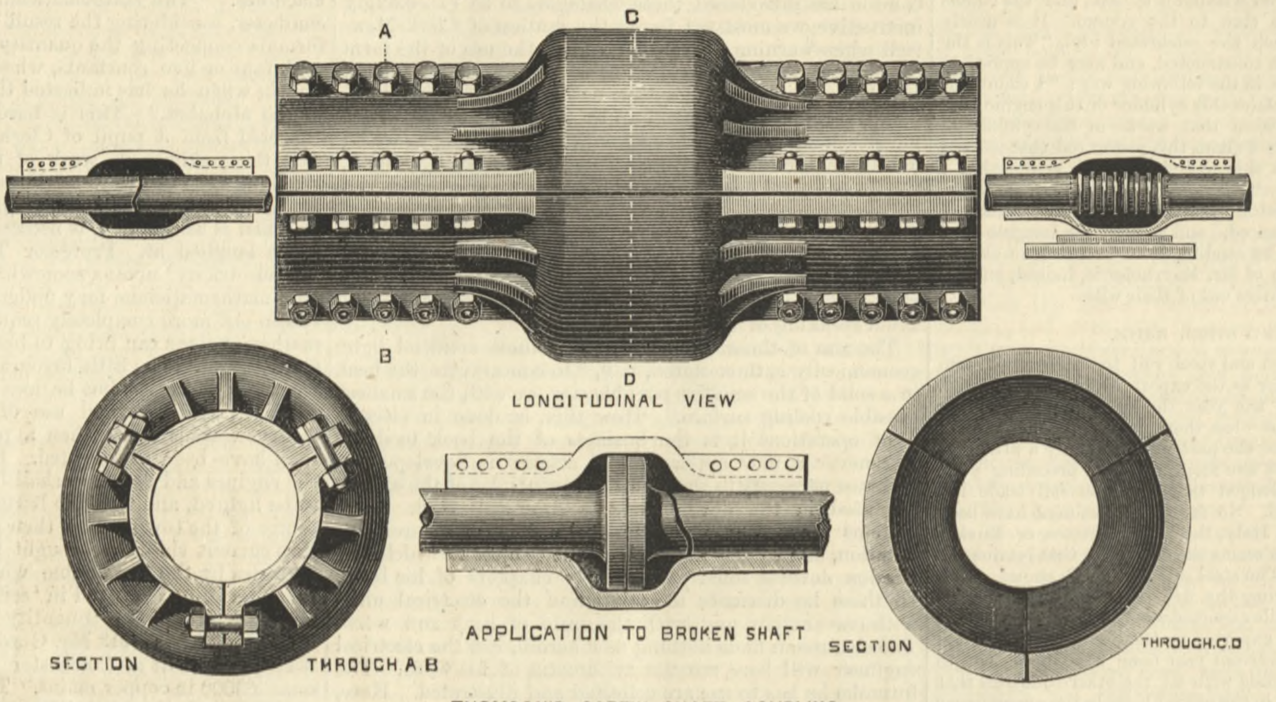


KORTUM'S ROPE ATTACHMENT.

alone. Before passing the feed into the hopper, the counterweight B in connection with the pressure plate in dotted lines in the hopper is adjusted on its lever, so that it will lift the plate as soon as there is less than, say, 2 lb. weight of feed on it. The catch C will then touch the angle lever A, which turns on its pivot, and the weight B, which hangs loosely on the pressure plate shaft, will fall down. The latter then knocks against the catch lever E, lever F is disengaged; the pressure is thus taken off the rolls by the spiral springs, and a distance of $\frac{3}{16}$in. intervenes between them. When putting the rolls to work again the weight B is put back in its old position and kept there by means of angle lever A. Lever G is then pressed down, and thus the pressure applied at a proper working distance of the rolls.

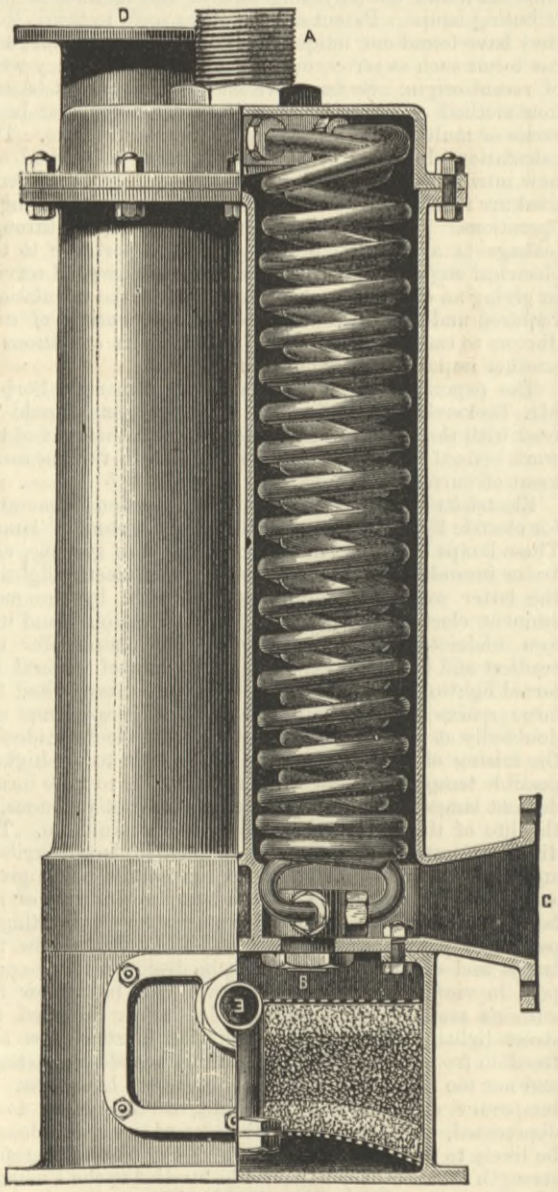
Mr. G. Telschow, London, shows a collection of Kortum's rope attachment, illustrated by the accompanying sections. These hooks are made with a taper socket; the rope end is put in, a pair of toothed wedges *k* are then inserted, and by forcing them in a little the pull on the rope completes their insertion, and the pull on the rope increases the tightness with which it is held. The wedges are rather more sharply tapered than the hollow cone, and the teeth decrease to nothing at *u*, so that the bite is gradually increased, and is a maximum at *o*. It is claimed that the rope is so held by this hook that its strength is unimpaired, and, to the German mind, this is the simplest way of putting it:—If the compressed end of the rope be considered as made up of elements, and if *w* represents the resistance in one element, Σw, will be at least = to the load (= P), if the rope is not pulled through. Therefore, the traction on the rope in the first element = P − *w* = P − *o* = P, and in the last element = P − Σw = P − P = *o*; if, therefore, the rope is not worn through successively at *u*, the pressure must be *nil* at *u*, and must be greatest at *o*. If at a circular section of the rope the pressure increases proportionately with the distance, the inner section of the wedge—the profile—corresponds to the equation of a parabola.

Messrs. Jessop and Sons show a collection of steel forgings and castings worthy of a best position in an exhibition of a high-class, well-attended character. A display of Ehlis's iron, steel, and Delta metal forgings is exhibited by Mr. H. Gebhardt, London, and is well worth the attention of engineers and architects; and Herr A. Milde exhibits one of the finest collections of ornamental wrought ironwork ever shown.



THOMSON'S SCREW SHAFT COUPLING.

One of the most attractive exhibits is a launch ready for service and built of Delta metal, a chemical alloy of copper and iron. The length of the launch over all is 36ft., breadth of beam 5ft. 6in., and depth from gunwale to keel 3ft., seating conveniently twenty-five persons. Delta metal having been proved by repeated experiments to be of equal strength, ductility, and toughness with mild steel, the plates and angle pieces of this launch were made of the same thickness as if steel were used,

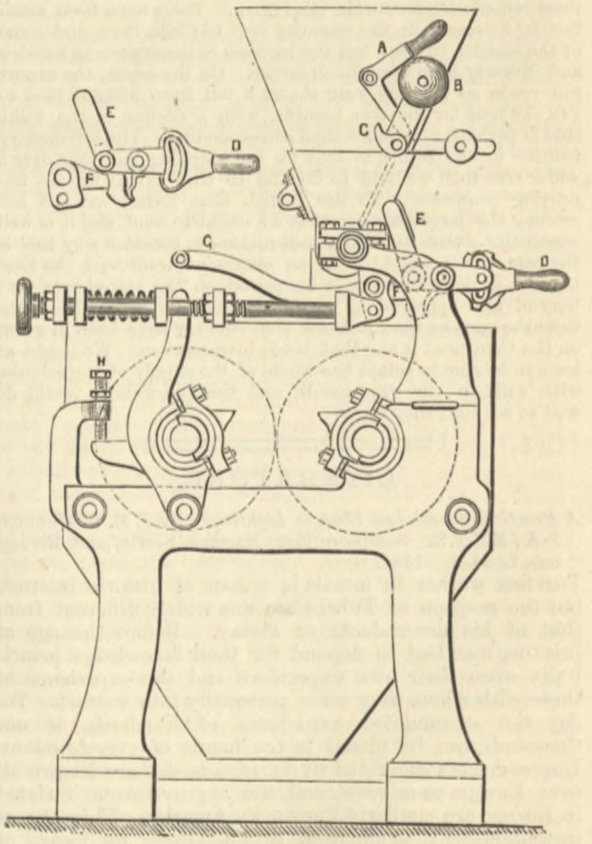


KIRKALDY'S DISTILLER.

viz., $\frac{3}{32}$in. thick. The stern, keel, and sternports are of forged Delta metal, and scarped together as usually done. The angle frames are made of the same material, and placed longitudinally instead of transversely, by which means greater longitudinal strength is secured. The propeller cast in Delta metal is four-bladed, 2ft. 4in. diameter, and with 3ft. pitch. The engine is of the usual direct-acting inverted type, of sufficient power to give a speed of from eight to nine miles an hour. The superiority which Delta metal possesses over steel and iron for shipbuilding is that it does not corrode as these do, and consequently fouling is also avoided. The rapidity with which a steel vessel corrodes unless continuously painted is well known, and it has been found to occur to a most remarkable extent in navigating the rivers draining the interior of the African continent, the water of which, for some cause or other not yet ascertained, possesses an extraordinary power of corroding and eating through steel plates. This fact is of interest at the present time, as the rapid development of the African Continent is looked for, and small vessels for navigating the interior will be numerously required. The new alloy Delta, not being very much dearer than steel, thus seems to meet the requirements.

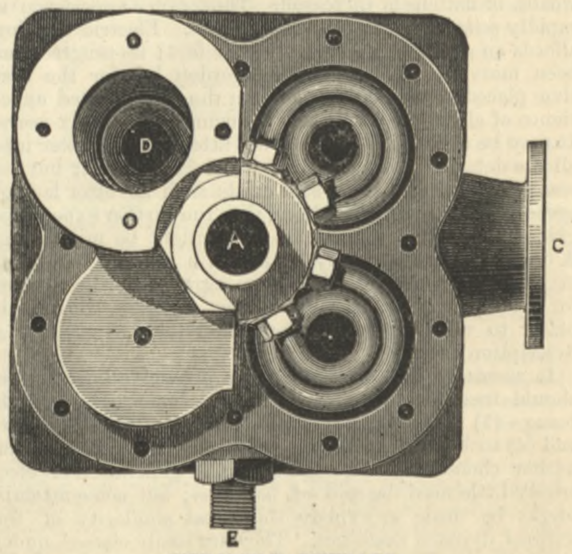
In the same department is a collection by Mr. J. Kirkaldy, London, of the fresh water distillers or condensers for use at sea, and wherever fresh water is required, from impure or salt water. One size of this condenser is shown in the annexed two engravings, from which it will be seen to consist of four single cylinders, enclosing small double copper spirals made of tube corrugated longitudinally. Below the condenser is a simple form of filter. These condensers are remarkably efficient, one of the size shown in the engraving producing 5500 gallons in twenty-four hours, and weighing only 300 lb. This distiller is now being made as a surface condenser for engines, and it gives excellent results, to which we shall refer on another occasion. The same manufacturer shows Thomson's coupling for broken screw shafts, a spare part which ought to be carried on every screw ship.

Messrs. Sharp, Stewart, and Co., show three machine tools of high quality. One is an 8in. slotting machine of very strong proportions, a screwing machine of the "Sellers" type, of which this firm have been the makers for some years, and which, it is claimed, is unequalled for speed of production; and a planing machine, also on Sellers' system. In this last, gearing is all but



KAHL'S ROLLER MILL.

dispensed with, there being but one pair of bevel wheels, driving a diagonal shaft, from which the motion is transferred to the table by a spiral pinion gearing into a rack on the underside of the table. The strap pulleys are large, and the strap shifting gear is of a special kind, two straps, open and crossed, being



KIRKALDY'S DISTILLER.

used, and being arranged to reverse without slipping and screeching, as when a single strap and small pulleys are used. There is also a fine collection of injectors on this stand, which shows that the original makers are not behind in new designs for special purposes. Amongst these is the "Atlas" injector, which has been specially designed for locomotives, the nozzles being removable without breaking pipe joints.

Messrs. Warner and Sons, London, are exhibitors of pumps, bells, &c., and the Britannia Company, of Colchester, exhibits a collection of small lathes, fret saw machines, &c.

There are many other things exhibited to which we cannot at present refer. We cannot conclude without remarking that though the invitations sent out by the Crystal Palace Company induced a good many German and other exhibitors to expend considerable sums to attend the exhibition, very little trouble seems to be taken to induce the public to visit the exhibition. There seems to be no more, if as many, visitors as usual, and the Health Exhibition still draws its thousands per day unaffected by the Sydenham show.

FOREIGN NOTES.

THE committee appointed by the Italian Parliament for the purpose of reporting on the shipbuilding policy of the Government have been furnished by the Minister of Marine with a statement showing the actual cost of some of the latest Italian ironclads. It appears that the Italia and Lepanto cost £960,000 each, and the three vessels of the Andrea Doria type, £800,000 each. The original estimate for the latter was £680,000. The two new vessels which are shortly to be laid down are expected to require an expenditure of £880,000 each. The original estimate for H.M.S. Inflexible was £587,185.

During her recent cruise the Duilio was found to roll to such an extent that it became necessary to transport her back to Spezia in order to replace the bilge keels, which had been removed for the purpose of improving her rate of speed. It was found difficult and even dangerous to work the guns whenever a moderately rough sea was encountered.

The director of the Buenos Ayres Arsenal, Col. Viegobueno, has arrived in Europe for the purpose of attending the tests of some 24 centimetre (9½in.) Krupp guns, twenty-four of which have been ordered by the Government of the Argentine Republic. The heaviest Krupp gun at present afloat is the 35½ centimetre —13⅞in.—steel breech-loader, mounted in the turret of the Danish torpedo ram Thordenskjöld. The following are a few particulars of this gun:—Total length of barrel, 8880 mm.; length of rifling, 7740 mm.; length of chamber, 1083 mm.; number of grooves, 80; length of twist, 45 calibres; weight of barrel with breech-piece, 52,000 kilos.; weight of steel shell, 525 kilos.; weight of bursting charge, 12·6 kilos.; weight of charge—prismatic cocoa powder—115 kilos.; initial velocity, 500 m.; total initial energy, 6690 m-tons; energy per cm. circumference of shell, 59·99 m-tons. The heaviest gun in use in the German navy is the 30½ cm. gun, weighing 36,600 kilos. As the Thordenskjöld has received orders to join the Danish squadron of evolution, her movements and trials will be watched with great interest by naval men at Copenhagen. It is said that this torpedo ram, though of about the same size as H.M.S. Polyphemus, was built at a cost only slightly exceeding the sum expended on the latter vessel in alterations since her launch. The speed of the English ram exceeds that of her Danish sister by about two knots per hour, but this is the sole advantage which she can claim, as will be seen by the following data:—

Polyphemus.		Thordenskjöld.	
Length, b.p., ...	241ft.	Length, b.p.	215ft.
Beam	40ft.	Beam	42ft.
Draught, aft	20ft.	Draught, aft	15ft. 6in.
Displacement	2640 tons	Displacement	2400 tons

The armour of the Polyphemus is composed of 4in. Whitworth steel plates, and the hull of the Danish vessel is protected in a similar manner; but, in addition, she is provided with a turret, armoured with 8in. plates. Both vessels are fitted with about the same number of torpedo tubes, besides which the Thordenskjöld carries a powerful armament of one heavy and several light guns, whereas the Polyphemus has only six machine guns. Both vessels are built of steel, and constructed specially for ramming.

The Forges et Chantiers Company, of Havre, is constructing a powerful twin screw cruiser, to be named the Noebi, for the Emperor of Japan. The hull, built of steel, is of the following dimensions, viz.:—Length, b.p., 321ft. 6in.; beam, 43ft.; depth, 27ft. 11in.; draught, mean, 18ft. 9in.; displacement, 3651 tons. She will be supplied by her builders with two distinct sets of engines of the latest type, indicating, together, 6000 horse-power, and calculated to propel the vessel at a mean speed of 15 knots per hour. The Noebi will be provided with apparatus for discharging Whitehead torpedoes, and she will carry a formidable battery, viz., two 18-ton guns and seven 6in. guns, all of French manufacture. Though intended to embody the principles advocated by Sir W. G. Armstrong, this cruiser differs in some respects from those built at Elswick, as, for instance, she is barque rigged, and carries a considerable spread of canvas.

The German squadron of ironclad gunboats at present cruising in the Baltic has met with a serious disaster. On the morning of the 4th inst. the squadron, consisting of the ironclads Biene, Krokodil, Hummel, and Chamaeleon, together with the despatch boat Grille, left Stralsund, and proceeded in the above order through the channel which divides the island of Ruegen from the coast of Pomerania. A strong westerly wind was blowing, causing the vessels to pitch very heavily, when the leading vessel, the Biene, suddenly struck a sunken rock, and immediately commenced to fill. Although the order to close the compartments was quickly given, three of them were filled, so the gunboat had to be run ashore on the coast of Fiem, in order to prevent her total loss. She was subsequently pumped out, and towed to Kiel for repairs. The above is the official version of the accident, which differs considerably from private accounts. According to the latter, the squadron had ventured some distance from shore when it was encountered by a stiff breeze and short, choppy sea, which swept the decks of the ironclads, and compelled them to make for shelter with all possible speed. It is affirmed that it was during this stampede that the Biene, being in advance of the rest of the squadron, met with her mishap. The Biene is an ironclad barbette gunboat of 1109 tons, carrying a 12in. Krupp gun, mounted in the bow behind a shield of 8in. armour.

THE 100-TON GUN ACCIDENT.—The accident that befell the 100-ton gun at Gibraltar was the bursting of a shell in the bore, which has scored and cut the tube, but has caused no serious injury to the gun.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending June 14th, 1884:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 9713; mercantile marine, Indian section, and other collections, 3273. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 6 p.m., Museum, 1694; mercantile marine, Indian section, and other collections, 225. Total, 14,905. Average of corresponding week in former years, 17,411. Total from the opening of the Museum, 21,125,346

LETTERS TO THE EDITOR.

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

PNEUMATIC MALTING BY THE GALLAND SYSTEM.

SIR,—THE ENGINEER has just published a very interesting article on "Pneumatic Malting" in reference to the malt-house established at Troyes by M. Bonnette. According to the instructions of M. Saladin this article has been reproduced in part in the French journal of the same name, *l'Ingénieur*, of the 9th of February last. The author of this article sets forth perfectly well all the advantages of pneumatic malting, of which he loyally grants me the paternity. The great economy of installation, the diminution of the expenses of fabrication, the advantages of permanent working, the obtaining products of regular quality, &c., all is exposed with the deepest conviction. The necessity of perfecting the baking is made manifest therein and treated sufficiently in its details.

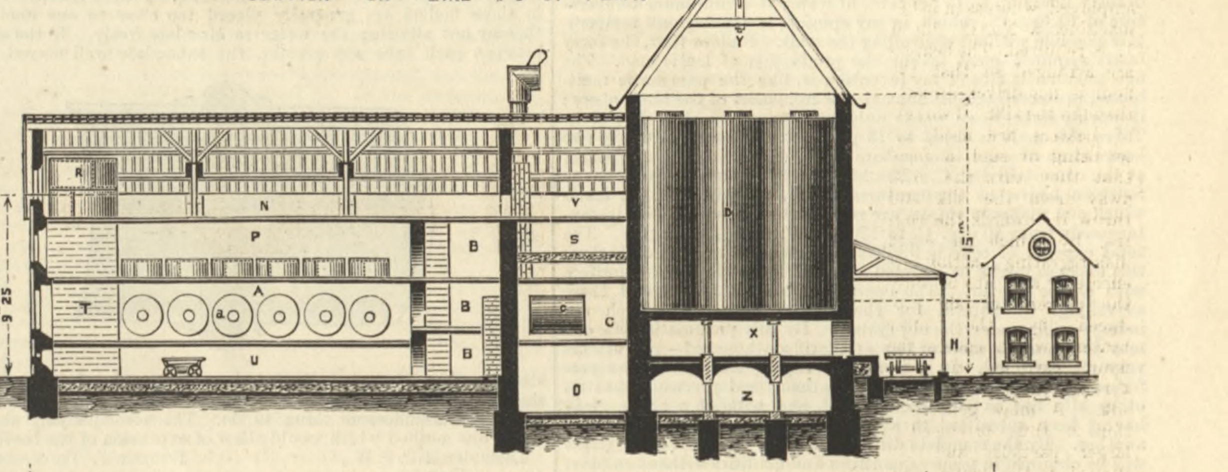
Its conclusion is that pneumatic malting will replace most advantageously the old system, especially in England, thanks to the new law on brewing, and that because of the irregularity of the seasons and the variety of the climates, this ancient system, in spite of all the improvements which have been made in it, can yield only products varying in quality. Nevertheless, I read in the article of THE ENGINEER among other things: "Mr. Galland created, eight or nine years ago, pneumatic malting. . . . Since that epoch other improvements have been realised by Mr. Galland, but more recently greater improvements have been effected in the

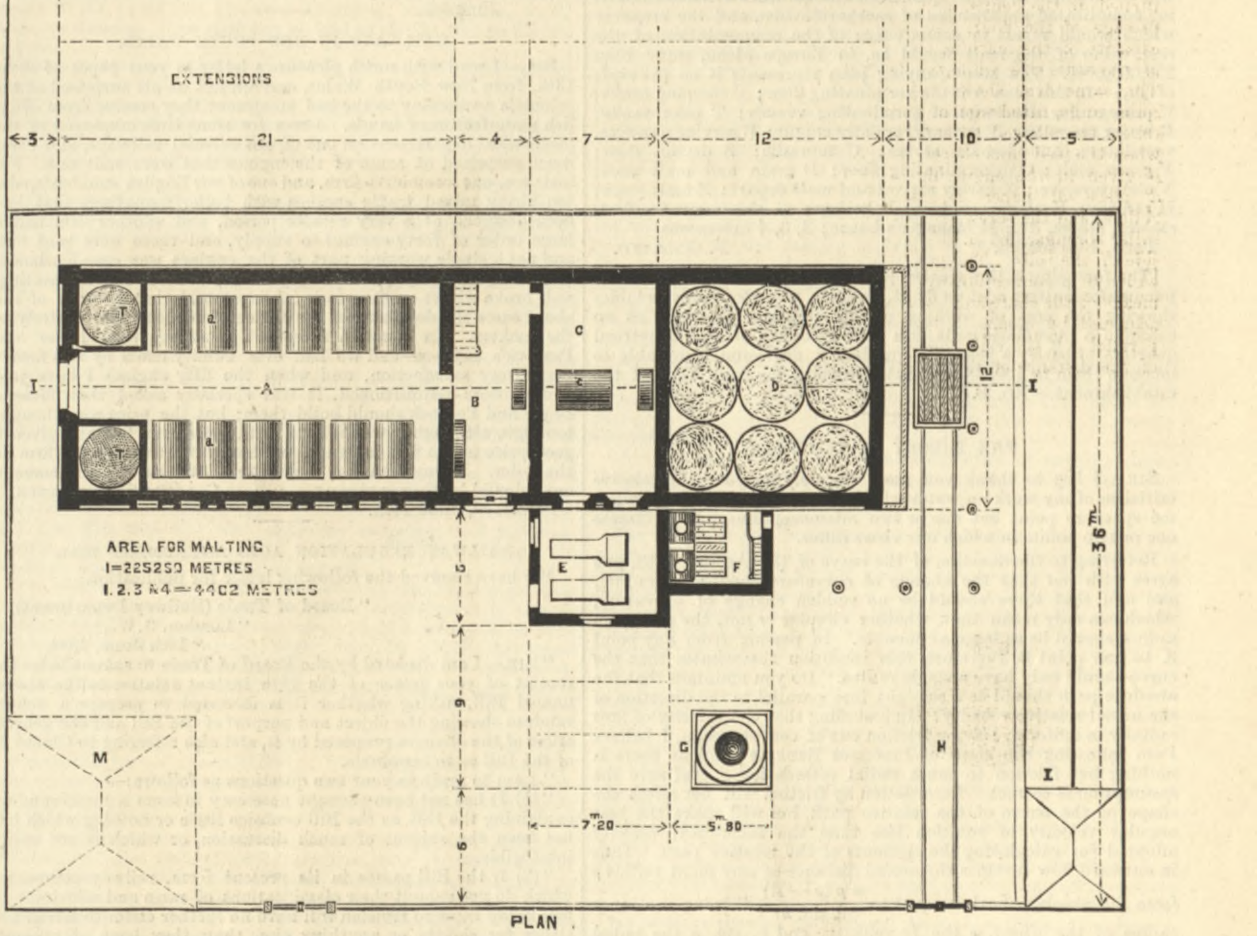
only be operated in taking the air of the room, but then the barometrical pressure in the latter being necessarily feebler by a few millimetres of water than that of the exterior, the doors, the invisible slits, and the pores of the walls allow the ordinary air to pass, which heats in summer and cools in winter that of the chamber, always influences its degree of saturation and temperature, and introduces ferments hurtful to the germination. In covering the cases—a thing very difficult and inconvenient—we may feed them by air coming directly from freezing apparatuses; but that is impossible with Saladin's retourneurs, placed on each case.

The carrying away of the green malt, after the accomplishment of the germination, is done more economically with my cylinders than with the cases, since the grain falls alone into the wagon which transports it to the kiln. The cleaning of the cylinders after each operation is also easier and more rapid. As for the net cost of the installations—a question which has not been treated in THE ENGINEER—I believe that there is no great difference between that of a malt-house with cases and Saladin's retourneur and that of a malt-house with cylinders of the same importance. In any case the difference would be in favour of my system, which occupies less space in surface and height.

THE ENGINEER gives the description of an apparatus employed by Mr. Saladin for the cooling and moistening of the air for the ventilation of the grain. This important question has given rise to many discussions, but it must be confessed that the interested ill-will of some persons has too often triumphed over the ignorance of others. Mr. Saladin's apparatus, which has also been patented in Germany by Mr. Linde, inventor of apparatuses for making ice, reposes on the principle of the action of the Alcarazas (Ger-

SECTION ON LINE I I OF PLAN





PLAN

system by Mr. Saladin." I think it my duty to protest against the assertion of THE ENGINEER, which appears to me to be thrown out rather lightly, in giving the results recently obtained by means of my new apparatuses for germination and baking. It is true that until two years ago I published none of my researches and of my different applications, so that it is natural that THE ENGINEER is but slightly acquainted with what I have been doing. Treating, first of all, of the germination, I must say that by my experiments I have been led to give the preference, instead of fixed cases, to cylinders in which the grain to be germinated, being submitted to a permanent ventilation, undergoes a constant movement of being turned over, but very slow—the cylinder making only one turn in an hour—and sufficient to prevent the entangling of the rootlets. The repartition of the temperature and the humidity is made in a perfect manner, for the grain, incessantly in movement without breaking any rootlets, acquires a temperature, so to speak, equal in all parts of the mass. On the contrary, in fixed cases with a great depth of grain there are always in the intervals of the turning over a difference of 4 to 5 deg. C. between the upper and the lower beds. That is the reason why in malt-houses with fixed cases I admit only 0·40m. of depth in the steeped grain, with a view to avoid in part these differences of temperature. In my cylinder for the germination, the arrival of the air more or less saturated and more or less cool, according to the age of the bed—an important thing admitted also lately by Mr. E. Velten—is very easily accomplished. As the cylinder acts by the aspiration and not by the compression of the air, we can give to a bed of grain, independently of its neighbours, a less saturated and warmer air at the end of germination, in order to obtain the fading of the malt. This last result cannot be realised with fixed cases installed like those at Troyes.

The ventilation by aspiration with uncovered fixed cases can

gelet), such as those of Golay, Galandat, and many others. For instance, an Alcaraza containing water at 30 deg. C., exposed to the air of these countries, whose temperature is 30 deg. C., will lower that of water to twenty at the end of a certain time, beyond which the temperature will remain stationary; this vase containing water at 0 deg. C. put in the same condition, will bring the temperature equally to 20 deg. C.; the cold produced is then only relative. In the countries of the centre of Europe, where the air is on an average saturated to the half, and in the countries of the north, such as England, where it is much more so, the effect of Alcarazas is but very little.

When Mr. Linde imagined his cooler, he did not intend to feed it with common water, but with water cooled by his ice apparatuses, which is a very different thing. The lower, or coke filter, of my invention fulfils all the conditions required for the effect to be produced. It consists in a lining in mason work or metal containing a grate, on which is placed a bed of coke; this latter, constantly watered in its upper part, is traversed in an opposite direction by the ventilating air. The apparatus works simultaneously by exchange of temperature between the water and the air, and by evaporation as an Alcaraza. The immense surface of contact that may be got with a relatively small quantity of coke permits the exchange of temperature and the evaporation to be made under the best conditions. The effect is naturally so much the greater and more regular as the water abounds and its temperature is low. When the water is wanting, then that which has passed through the filter is brought up to the higher part by means of a pump, and so the filter works by evaporation alone; its action is more efficacious, because of its surface, than that of Saladin's, whose mechanical movement demands as much force as the pump—which, by the way, is of little importance. I have established by experiment that with a quantity of fresh water equal to fifteen times the weight of the grain for the steeping and the coke towers, we are in good conditions even in the climate of Marseilles. The apparatus employed by Mr. Saladin in the malt-house at Troyes offers a surface of about 250 square metres; a coke tower containing 56 cubic metres of coke presents a minimum surface of 2000 metres, and has the advantage of costing much less and of giving purer air. In fine, the great section that a coke tower gives to the passage of the air renders it, whatever one may say, the most economical apparatus as regards the force to be expended in moistening and tempering the same volume of air in all seasons. It has been said that the spaces between the pieces of coke became filled up in the end by mushrooms, which obstruct the entry of the air and are prejudicial to its purity. I have hardly ever remarked this fact, but the new improvements which I have made in its construction would prevent this inconvenience from being produced. We cannot yet conclude anything from Saladin's apparatus, employed for the first time at Troyes, since the malt-house began to work in November, 1883; it is only after the warm months of June, July, and August, that we shall really know whether it is worth anything or not, as well for the saturation as for the cooling of the air. It might even happen in winter, on icy days, that the apparatus might be thereby obstructed and cease to work, unless one uses, for a malt-house of 100 metric quarters a day, for instance, 8 kilos. of vapour a minute. A coke tower for a malt-house of the same importance, with 356 litres of water a minute, which is not rare to be found, would give air at 12 deg. C. to the germinating apparatuses, and would let the water flow out at less than 0 deg. C. In this extreme case the coke tower, which had not enough water, will always consume less vapour than Saladin's apparatus, since it works by exchange of temperature.

As for the question of kiln-drying, THE ENGINEER gives the results obtained by Messrs. Stopes and Co., of London, in a malt-house at Pultorseed. By their system the green malt would dry in forty hours up to 15 per cent. of water at a minimum temperature of 61 deg. C., which, in my opinion, is the highest temperature possible without shrivelling the malt. Besides that, the forty hours required must favour the production of lactic acid. The new pneumatic kiln of my invention is, like the pneumatic malt-house, protected against the exterior influences of the atmosphere; it works, since three weeks only, at Mazingarbe—Pas de Calais. There the malt is dried to 15 per cent. of water in twenty-two hours at an average temperature of 36 deg. C., without surpassing at the utmost 50 deg. C. The kiln-drying is done in from ten to fourteen hours, at temperatures which, according to the malts which one wishes to obtain, are regulated at pleasure, and instantaneously from 50 deg. C. to 120 deg. C., and even higher. The total expense of coke is 9 kilos. for a metrical quarter of barley; this expense might be reduced one-half by employing a calorifere with escape vapour. The operation necessitates none of those shovellings so painful for the working men, and which are indispensable under the old system. By this pneumatic kiln one may obtain malts more or less saccharified—honeyed—and always very disintegrated. In a word, the drying and baking are performed under my system with a mathematical precision that no other kiln has as yet accomplished, and without a single grain having been submitted to a temperature different from that of another. By the complete disintegration of the malt the extract will be obtained in proper quantities and qualities without employing complicated apparatuses of saccharification, and the economy which would result in consequence of the augmentation of the real value of the malt would be, in Europe alone, more than 250,000,000f. The accompanying plan represents it on the scale of $\frac{1}{400}$:—In this plan A is the germinating floor; P steeping tanks; U passage for discharge of germinating vessels; T coke tanks; R water reservoir; N granary for daily supply; B service passages, ventilators, and hot-air stoves; C touraille; S drying floor; V green malt; O degerminating floor; D grain and malt silos; Y elevators, &c.; X barley arrival and malt depart; Z malt store; H railway; E steam engines; F boilers; G chimney; I offices, stables, stores, &c.; M manager's house; 2, 3, 4 extensions.

Paris, 15th March. F. GALLAND.

[The foregoing is the greater part of a long communication on pneumatic malting sent us by M. Galland, who also sends us tables showing the cost of working on his system. He takes as an example a pneumatic malt kiln with cylinders of 25,000 metrical quarters of barley a year—75 quarters a day—and being able to increase them to 100,000 without disturbing the daily work of the establishment.—ED. E.]

THE THEORY OF TURBINES.

SIR,—I beg to thank you most sincerely for your appreciative criticism of my work on water-wheels, and feel sure you will allow me space to point out one or two misconceptions, and to discuss one or two points in which our views differ.

Referring to the question of the curve of the absolute path, you agree with me that the change of curvature should be gradual, and add that there should be no sudden change of curvature, which can only mean that, whether circular or not, the minimum radius should be as large as possible. In passing from any point A to any point B, therefore, this condition necessitates that the curve should only have a single radius. Do you maintain that the absolute path should be a straight line parallel to the direction of the initial relative velocity? In assuming that the velocity of flow radially is uniform, leaving friction out of consideration, I believe I am following the steps of Professor Rankine; and as there is nothing but friction to cause radial retardation, I feel sure the assumption is correct. Retardation by friction will not affect the shape of the curve of the relative path, but will make the best angular velocity of rotation less than the theoretical velocity adopted for calculating the elements of the relative path. Thus in outward-flow turbines the arcual distance of any point radius ρ from the absolute path is equal to $\frac{\omega\,\rho\,(\rho - R)}{v.\ \sin.\ \alpha}$, R being the inner radius of the wheel, ω the L^r velocity, and $v.\ \sin.\ \alpha$ the radial velocity. Now if by friction $v\ \sin.\ \alpha$ is reduced to $c\ v\ \sin.\ \alpha$, where c is a co-efficient less than unity, the relative path will suit an angular velocity equal to $c\,\omega$. This best angular velocity must be determined by actual experiments with the wheel. The co-efficient determined by experiment with one wheel will probably be constant for all sizes of wheels in which the value of the ratio $\omega\,\rho \div v\ \sin.\ \alpha$ adopted is the same.

You overlooked the basis of the reasoning which led to the conclusion that the theoretical efficiency of a Poncelet vane will be equal to $\cos.^2\,\alpha$. This result has been arrived at on Rankine's assumption that the energy lost by the water is wholly communicated to the vane—the very assumption which I have endeavoured to prove, and think I have succeeded in proving, to be untenable. I have nowhere stated that the efficiency of the best turbines must be less than 50 per cent. I have stated that I do not think it can exceed 60 per cent. In the eyes of the chemist water may possess viscidity, but so far as the investigations of the hydraulic engineer are concerned, water may certainly be regarded as a fluid perfectly free from viscidity. I cannot agree with you in your views as to the correct definition of elasticity, which is the property which bodies possess in different degrees to return to their original shape when the force causing deformation is removed.

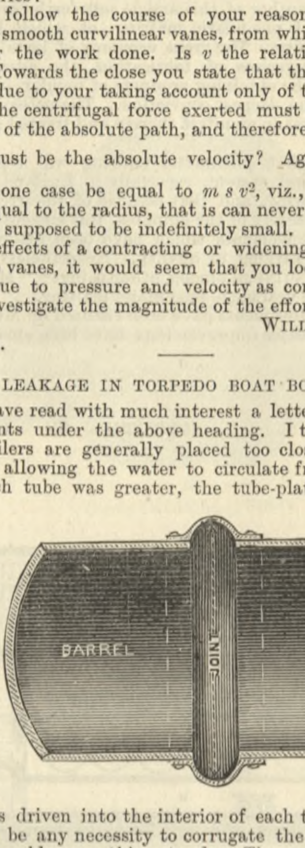
Elasticity may therefore be defined as the force of restitution; no bodies probably are perfectly elastic and none perfectly inelastic. In works on the strength of materials the tables usually contain a column headed "Modulus of Elasticity," which gives the force necessary to extend a bar of the material of 1in. sectional area to twice its length, calculated, of course, on small extensions. This modulus has therefore in reality nothing to do with the elasticity of the material, and is therefore erroneously described; it ought to be called the modulus of extension. Strange to say, these tables never contain the value of the modulus of compression. The usual formulæ for the strength of solid beams are based on the equality of these moduli, which in some materials—cast iron, for instance—have widely different values, and in consequence the calculated breaking weights are much less than the experimental ones. In a small work published by myself, in 1872, I worked out a formulæ in which account is taken of both moduli, and which gives results which agree exactly with experiment. No reviewer has as yet taken up this question, and new works continue to be published in which no account is taken of the modulus of compression. Will you take the matter up and criticise my book on solid beams in the same spirit that you have criticised my turbine theories?

I cannot follow the course of your reasoning on the flow of liquids over smooth curvilinear vanes, from which you deduce your formulæ for the work done. Is v the relative or the absolute velocity? Towards the close you state that the simplicity of your formulæ is due to your taking account only of the relative velocity; but surely the centrifugal force exerted must be due to the shape of the curve of the absolute path, and therefore v in the expression $m\ s\ v^2\,\frac{l}{r}$ must be the absolute velocity? Again, this expression can only in one case be equal to $m\ s\ v^2$, viz., when the length of the arc is equal to the radius, that is can never be so, as the length of the arc is supposed to be indefinitely small. From your description of the effects of a contracting or widening of the water-way between the vanes, it would seem that you look upon the sum of the heads due to pressure and velocity as constant. Is this so? You only investigate the magnitude of the effort. How about the work done? WILLIAM DONALDSON.

June 12th.

LEAKAGE IN TORPEDO BOAT BOILERS.

SIR,—I have read with much interest a letter from one of your correspondents under the above heading. I think that the tubes in these boilers are generally placed too close to one another, thereby not allowing the water to circulate freely. If the space between each tube was greater, the tube-plate well stayed, and



steel ferrules driven into the interior of each tube, I do not think there would be any necessity to corrugate the shell, which would be a very troublesome thing to do. The accompanying sketch shows one method which would allow of expansion of the barrel.

Lavender Hill, S.W., ROBERT F. THOMPSON.
June 5th.

RAILWAYS IN NEW SOUTH WALES.

SIR,—I read with much pleasure a letter in your paper of June 13th, from New South Wales, and am not at all surprised at the colonials awakening to the bad treatment they receive from English manufacturers' hands. I was for some time employed in the mechanical department on one of our colonial railways, and I was much surprised at some of the engines that were sent out. For instance, one locomotive firm, and one of our English standards, sent ten heavy mixed traffic engines with boiler mountings that had been designed at a very remote period, and another firm had a large order of forty engines to supply, and these were sent out, and not a single working part of the engines was case-hardened, and before they had been running twelve months five connecting-rods broke whilst on the road. I must add that in each of the above cases the designing of the engines had been left entirely to the makers. In common fairness I must say that Beyer and Peacock's engines—and we had over twenty made by this firm—gave every satisfaction, and when the fifty engines I have just quoted were requisitioned, it was specially asked that Messrs. Beyer and Peacock should build them; but the price was thought too high, although it would have paid twice over to have given a good price in the first instance, and have let a trustworthy firm do the order. I trust that we may hear a little more from some of our colonial brother engineers. COLONIAL EXPERIENCE.

Stratford, June 14th.

RAILWAY REGULATION ACTS AMENDMENT BILL.

We have received the following letter for publication:—

"Board of Trade (Railway Department),
"London, S.W.,
"18th June, 1884.

"SIR,—I am directed by the Board of Trade to acknowledge the receipt of your letter of the 11th instant relative to the above-named Bill, asking whether it is intended to prepare a memorandum showing the object and purport of the Bill and the general effect of the changes proposed by it, and also referring to Clause 21 of the Bill as to terminals.

"I am to reply to your two questions as follows:—

"(1) It has not been thought necessary to issue a memorandum explaining the Bill, as the Bill contains little or nothing which has not been the subject of much discussion, or which is not easily intelligible.

"(2) If the Bill passes in its present form, railway companies which do not submit their classifications of rates and schedules of maximum rates to revision will have no further claim to terminals, either for sidings or anything else, than they have at present. Those companies which do submit their rates will necessarily bring their whole case before Parliament, and give to opponents the opportunity of asking the Parliamentary Committee, to which their Bills are referred, to insert any conditions which may be necessary for their protection; and even where no such special conditions are imposed, the clause in the present Bill with respect to terminals will only give the companies such rates, by way of terminals, as the Railway Commissioners may think reasonable.

"I am, Sir,
"Your obedient servant,
(Signed) "HENRY G. CALCRAFT.

"Thomas Colborne, Esq., Newport, Mon."

THE FUTURE PROSPECTS OF YOUNG ENGINEERS.

SIR,—I am very glad to have had my views on this subject corroborated by "Draughtsman's" letter, which appeared in your issue of June 13th. But I must confess my surprise on reading the letter by Mr. Jones, wherein the writer, although apparently endeavouring to show that the future prospects of young engineers are satisfactory, has not made a single statement to prove that they are so; on the contrary, his own statements tend to confirm my own opinion.

Mr. Jones very kindly informs us of a few facts of which we are all well aware. He states that at present every prospect is held out to young engineers, and by his next remarks evidently means every prospect in the way of learning their profession. That is perfectly true; but let him tell me a single prospect which a young engineer has of getting a situation, or appointment, when he has learned his profession unless it be, as "Draughtsman" most correctly states, by capital or influence.

The benefits which Sir Joseph Whitworth has conferred upon his profession are almost proverbial, and yet Mr. Jones has, I may almost say, the presumption to inform the readers of THE ENGINEER that "Night classes for practical as well as theoretical work are available. . . . Large Engineering Colleges have been opened. . . . Sir Joseph Whitworth also holds out scholarships to deserving pupils," thus monopolising your valuable columns, which might have been used for information both interesting and instructive to the engineering profession in general. I am not aware that in my letter I even insinuated that it was impossible for good men to get on; I only mentioned the fact—and I think proved it—that it was extremely difficult for young engineers to get employment, which of course is a totally different thing. For men who do not understand their profession I have no sympathy, but if, as Mr. Jones appears to think, there are no good men to be obtained in England, I mus beg to differ, and I think many of your readers will be on my side. That Mr. Jones does think so, is apparent by another remark, namely, "that the reason why our firms employ Germans is because they are good mathematicians and mechanics," which is equivalent to saying that the English are not. This I emphatically deny, and I think your numerous readers and contributors must have been very much surprised at reading it.

And now, Sir, I fear I have already trespassed on your kindness, but in conclusion must express my great satisfaction that my letter of May 30th has had the desired effect, viz., of commencing a discussion on this most important subject.

In the case I mentioned in my last letter, did I not state that the pupil had attended evening classes, and thereby made himself far more competent than he would have been otherwise? Was it not, therefore, quite unnecessary for Mr. Jones to inform us that "night classes are available?"

CLAUDE E. AUDAIN.

June 17th.

SIR,—With your permission, I should like to say a few words in reply to a letter which appeared in your paper of the 13th from Mr. Jones. He states that at the present time every prospect is held out to young engineers, in the form of night classes, &c. I quite agree with him on this point, and I think young men might, with great advantage to themselves, improve their theoretical knowledge more than they do. The practical part is, in my opinion, better obtained in the large shops and engineering works than in the shops attached to the schools and colleges. Your correspondent then goes on to say "that great engineering works are projected," but he fails to enlighten us as to the nature and whereabouts of these great works. Certainly, your weekly columns of advertisements do not speak in his favour, either for proposed works or assistants required. As a member of the profession, and having been engaged upon important works at home and abroad, I can assure Mr. Jones that with all the present advantages, it will not find our young engineers employment. And what is the reason? Simply because there are no works of importance going on. I admit that there are many young men who call themselves engineers who know very little about the practical part of their work.

As regards Mr. Audain's remarks on the treatment of pupils after their time has expired, and the manner in which trading in pupils is carried on, all I can say is that it is true, and I could quote many such cases—a certain London office in particular. For your correspondent to try and paint such a picture as he has represented is absurd. I think the majority of the young men who have been trained in the offices and shops of our large works, and with respectable employers, are as promising as can be expected, and the only thing that is wanted is work to enable them to show their abilities. These are the poor unfortunate creatures your correspondent would throw overboard for the sake of cheap foreign competition. What an honourable member of the profession! our foreign relations should indeed feel flattered at having such an advocate. I have had a good deal to do with foreign engineers and workmen, but from experience I am led to believe that our own countrymen make the most willing and practical men.

So long as the pernicious system of taking pupils for the sake of their premiums goes on, I think every one will admit that we can hardly expect to have good men. Your correspondent has tried to make out that Mr. Audain is under the impression that engineering can be learnt without hard practical work. All I say is that no one can become proficient in any trade or profession without it.

June 17th. A CIVIL AND MECHANICAL ENGINEER.

ELECTRICAL GOVERNORS.

SIR,—I notice in your edition of the 13th inst. a description of an electrical governor made by Mr. P. W. Willans, which no doubt will lead many of your readers to suppose that Mr. Willans has originated a novel and ingenious mode of regulating the dynamical production of electricity. In order that this idea may not be taken up by the public, I wish to point out that Mr. Willans' apparatus is almost identical with the electrical governor patented by Mr. Geo. Westinghouse, jun., more than eighteen months before Mr. Willans.

The following short description of Mr. Westinghouse's governor will show that it applies word for word to Mr. Willans' apparatus, which latter therefore must necessarily be considered as a mere repetition of Mr. Westinghouse's invention:—"The core of the solenoid is drawn in one direction by magnetic attraction, and in the other direction by an adjustable spring. When the influence of the current increases and moves the core, the distributing piston valve is put in such a position that fluid is admitted to a cylinder, and forcing the piston, partly closes the regulating valve of the engine." The patent in question of George Westinghouse, jun., is No. 3409, dated 6th August, 1881.

London, June 18th. A. KAPTEYN.

[We insert Mr. Kapteyn's letter, but we must remind him that it proves nothing. Electrical governors have been patented before either Mr. Westinghouse or Mr. Willans stirred in the matter. The principle involved in all governors of the kind is the same; the differences are purely in matters of detail—excellent subjects for patents. Unless Mr. Westinghouse's governor is identical in details with Mr. Willans' it is improbable that the one can clash in any way with the other, and on this point Mr. Kapteyn's letter really throws no light whatever.—ED. E.]

WATER TUBE BOILERS.

SIR,—As former engineer and manager and present London representative for the makers of the "Root" boiler, I have had exceptional opportunities for closely observing the various water-tube boilers used in this country and on the Continent during the last fifteen years.

Leaving defects in construction out of the question, I am of opinion that the prejudice in this country against them is owing to omission in taking the two following facts into consideration when advocating the use of water-tube boilers, as hitherto made: (1) That no boilers with small water and steam space are for certain purposes as suitable as those possessing such of large capacity; (2) That incrustation, as resulting from indifferent or bad feed-water, affects the economy, efficiency, and general steaming qualities, &c., of a water-tube boiler in a much higher degree than it affects some other types of boilers. Those makers of water-tube boilers who have overlooked or not cared to look into above facts when orders offered, have not only damaged the reputation of their own particular boiler, but have brought discredit on water-tube boilers in general. On the Continent, where these considerations have been taken better into account than in this country, the demand for water-tube boilers is much on the increase. As it is now also proved in this country beyond doubt that "Stollwerck's patent feed-water purifying apparatus," arranged to form part of a water-tube boiler, practically prevents incrustation in the tubes, however bad the feed-water may be—at the same time as the apparatus greatly increases the water and steam space—the field for an advantageous use of the water-tube boiler has been considerably extended. As regards economy, efficiency, and general steaming qualities of various types of steam boilers, it would go far towards settling these matters if a public trial, extending over a lengthened period and under fair and proper working conditions, could be arranged by an influential body of engineers and steam users, not interested in boiler making. Makers of steam boilers, who have confidence in their speciality, would only be too glad to assist in such a matter.

I do not think that claims for facility in transport and repairs, rapidity in getting up steam, suitability for high pressures, and above all safety against dangerous explosions, can be denied to a properly constructed and well made water-tube boiler.

CONRAD KNAP.

11, Queen Victoria-street, London, E.C., June 17th.

SIR,—When the Root boiler is quite clean and fired moderately, I estimate the saving in coal to be upwards of 10 per cent. over the best Lancashire; but when the tubes become incrusted and fires have to be forced, the favourable comparison disappears altogether. If anything could be done to insure the prevention of scale, or even diminish it, a great point in favour of water-tube boilers would be gained. Their comparative safety is a great consideration.

Charing-cross, June 17th. C. E.

WORKING REFRACTORY TITANIC ORES.

SIR,—For many years past the deposit of iron sand both on the shores of New Zealand and of Canada has been the object of much solicitude on the part of the Governments of these countries, who have endeavoured to use this raw material which is so rich in metallic iron, and of which there is almost an inexhaustible supply, to a commercial advantage. It was urged that the absence of suitable fuel within reasonable distance of the deposits would always be an insuperable obstacle in the way of using up the sand on the spot, yet that obstacle, serious as it seemed, would appear to be overcome, as coal and slack from Waikato may be obtained which is suitable for gas producing.

Having experimented with these sands, I have been able to obtain good and satisfactory results, both as to its qualities in iron and steel, either by working it into finished merchant bars or converting it into soft steel by the Siemens open hearth furnace, or by making crucible steel of a high quality. I treated the sands as under: After working the sands in the Siemens rotary furnace, reduced with charcoal or soft coal, the balls were hammered into blooms; these were rolled into good merchant bars suitable for the market; to produce crucible steel, bars were cut up into small pieces, which is usually done, and melted in crucibles, the production of which was a very fine quality of steel. For producing mild steel for plates, &c., in the Siemens open hearth furnace, the balls were taken from rotator and hammered or squeezed into blooms, then charged with exact proportion of pig iron, and gave excellent results; and so far as my experience has gone with treating ores of almost every nation direct both by puddling and with the revolving process, I have found nothing so well adapted to treat direct as these sands.

It has been proved by experience that to work ores or magnetic sands direct they must contain a high percentage of metallic iron; this we have in these sands, as the appended analysis shows; and although so much has been expended in these countries in experiments to work up these sands, yet I have not read of any proving successful. To puddle it is by far too slow a process, and too expensive. What then is required is a process which will be able to make a large output with very little cost, and will be able to meet the demands of the country; and as this Siemens furnace has now passed its experimental stage, it can be built so that with one rotator 30 tons of blooms per week can be made.

Having in previous letters described the principle of this furnace, it is useless for me to take up your valuable space again. Suffice to say, with a little improvement in the construction of these furnaces, which only by practical experience has been attained, the furnace could be made to work for three months or more without undergoing any repairs; besides, with this process no skilled labour is required, therefore the cost for labour would be very low. This alone is a great advantage, as it is the high price paid for labour in some of our manufactures that prevents us from being able to compete with foreign countries. In fact, with working two or more rotators jointly, blooms could be produced at a cost of 5s. per ton for labour.

The analyses of titanic sand is as follows:—

Peroxide of iron	67·04	} = iron 70·4
Protoxide of iron	30·17	
Oxide of manganese	·22	
Alumina	·16	
Lime	trace	
Magnesia	trace	
Titanic acid	1·64	
Sulphuric acid..	trace	
Phosphoric acid	·08	
Silica	·51	
Moisture	·14	
	99·91	

Mossend Steel Works, June 18th. JAS. DAVIS.

HYDROGEN LAMP.

SIR,—It may interest some of your readers to know that the hydrogen lamp illustrated by you in your journal of the 13th inst., and described as "a recent application in a very convenient form by Messrs. Newton and Co., of the fact that a stream of pure hydrogen striking on spongy platinum makes the platinum red hot—so hot, in fact, that the platinum in its turn lights the gas"—is identical in all its details, including "the ingenious idea" with the well-known Döbereiner hydrogen lamp, which I saw in use in many private houses in Germany forty years ago, and one of which, dating from that period, it was my duty as a youngster to keep in working order for domestic use. F. A. ABEL.

Royal Arsenal, Woolwich, June 17th.

[Another correspondent has written us on this subject. We may point out that no novelty was claimed for this lamp, but that the main idea involved is probably applicable in other important directions. Though the lamp in some form is old, it has been so long out of sight as to be new to many readers.—ED. E.]

HYDRAULIC TURNTABLES.

SIR,—In the sketch and account of an hydraulic turntable at Millwall Docks in this week's number of your paper, mention is also made of one having been made a few years ago with the spiral guides outside. I beg to state that one with outside guides was made for the Mersey Steel and Iron Company's Works more than twenty years ago by a firm of engineers in Liverpool. It was erected for the purpose of lifting the trucks of coal from the level of the Liverpool and Garston Railway to two different levels for supplying the works. I should not have troubled you about this, but from the account in your paper of one made by Sir W. Armstrong and Co., one might be led to suppose that it was the first and only one made on that principle. I ought to have mentioned that the one at Liverpool was made according to the directions of Mr. Wm. Clay, a member of the firm—Mersey Steel and Ironworks. June 17th. J. J. A.

TELPHERAGE.

SIR,—In answer to the inquiry made by "Viator" in your last issue, I would estimate the cost of a telpher line to convey 10 tons per hour for a distance of 1½ miles as follows:—If the gradients are unfavourable and the load has to be worked up-hill, the first cost, including engine, boiler, shed, dynamos, countershaft, belting, line, sidings, rolling stock, royalty, freight and agency, might be about £3000. If the gradients were favourable, and the load carried either on a level or down hill, only the empty trains running up-hill, then cost might be reduced to about £2000. If "Viator" thinks these figures satisfactory, I should be happy to give him further particulars in answer to a direct inquiry.

Offices of the Telpherage Company, FLEEMING JENKIN.
Limited, 53, Old Broad-street,
E.C., June 16th.

SIR,—It was recently stated to me that the word Telpherage was derived from telegraph and phosphorus!!!

I note your derivation; permit me to give two others. One is τῆλε, "far," and φῶς (*phos*), "light." Thus we have "light railway," by inverting the sense, distorting τῆλε, and punning with phos.

The real derivation of the word is, I believe, τῆλε and φορέω (*phoreo*), "I carry constantly." If this is so, then the word should be, as explained by Professor Jenkin, "telephor," the last syllable having, of course, nothing to do with the phone of telephone.

Cambridge, June 17th. ALPHA.

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

(*From our own Correspondent.*)

THE threatened colliers' strike has for the present been tided over. The Coalmasters' Association resolved that the men shall be allowed a fortnight's notice before the award pronouncing a reduction is to be enforced. The committee in taking this action followed an example which had been first set by the Earl of Dudley in dealing with his own men. Mr. Joseph Rowlands, the arbitrator, has stated that he cannot attend any meeting of the Wages Board to reopen the question; and all hope of a meeting of the Wages Board being therefore cut off, the colliers would now be on strike but for this concession by the masters. At some of the pits a strike did begin on Monday, but upon its becoming known that a fortnight's grace would be allowed work was resumed. Whether any steps will be taken to prevent a rupture when the notice expires on the 28th inst. is at present very doubtful. The masters say they shall then require the award to be observed, and the men seem equally determined not to accept it. In the meantime the men have decided that no extra work shall be made between now and the 28th, so as not to play into the hands of the masters.

The impression upon 'Change in Birmingham this—Thursday—afternoon was that a way will be found out of the difficulty without either strike or lock-out being resorted to. Upon the iron market the effect of the threatened rupture has been very slight. Business, therefore, remains almost entirely in its normal condition. Yet, until a definite agreement has been come to, the market will remain a little disturbed in one or two of its branches.

The orders arriving at the works do not show an increase in other than exceptional instances, where the demand for medium quality iron, for home consumption, has been rather improved. Only part of the mills are running, since masters refuse to accept inquiries that are unremunerative.

Hoop and bar makers complained this afternoon of the competition of Northern firms, particularly those of Lancashire, who by reason of their closeness to Liverpool, can execute work at below Staffordshire prices.

Native hoop makers quoted £6 to £6 5s. at works, which means £6 10s. to £6 15s. delivered Liverpool, and £6 15s. to £7 delivered London. Gas strip can be had at £5 12s. 6d. to £5 15s. and on.

Common bars are £5 15s. to £5 17s. 6d. and £6, and medium quality bars are £6 10s. to £6 15s.

William Barrows and Sons quote hoops of from 14 to 18 w.g., £8; best hoops, £9 10s.; best matched slit rods, £9 10s.; second best, £8 15s.; double best charcoal slit horse nail rods, £16 10s.; and double best rolled ditto, £18. Strip, fender, and plough plates, to 14 w.g., are £9; and best ditto, £10 10s. Plating bars are £8; best ditto, £9 10s.; double best charcoal, £16; best angle and rivet iron, £9 10s.; and double best, £10 10s. Sheets to 20 w.g. are £9; 21 to 24 w.g., £10; and 25 to 27 w.g., £12.

E. T. Wright and Son quote Monmoor crown bars of ⅛in. to 3in. round and square, or to 6in. flat, £7 5s.; best, £8 5s.; double best, £9 5s. Rivet iron of usual sizes is £9 to £10, according to quality; angles to 8in. are £7 15s. for ordinary, £8 15s. for best, and £9 15s. for double best. Tees are quoted £8 5s., £9 5s., and £10 5s., according to quality. Hoops from 16 to 19 w.g. are £7 10s.; 20 w.g., of ⅝in., £8 5s.; and 20 w.g., of ⅜in., £9. The Wright qualities of this firm are 10s. per ton under the above rates.

Sheets of the Woodford brand were quoted to-day at £8 5s. for 20 b.g., £9 15s. for 24 b.g., £11 5s. for 26 b.g., and £11 15s. for 28 b.g. delivered at out ports. Close annealed Woodford crown sheets were £9 10s. for 20 g., £11 for 24 g., £12 10s. for 26 g., and £13 for 28 g. Woodford best were £11, £12 10s., £14, and £14 10s. respectively, according to gauge. Charcoal sheets were quoted £16, £17 10s., £19, and £19 10s., according to gauge; and Siemens-Martin close annealed sheets £13 for 20 g., £14 10s. for 24 g., £16 for 26 g., and £16 10s. for 28 g. at outports.

The basic steel works of the Staffordshire Steel and Ingot Iron Company, at Bilston, will ultimately give employment to several hundred hands. The weekly out-turn will, it is believed, be soon 500 tons in the shape of sheets, angles, bars, &c. These it is hoped will find a market amongst the tin-plate and sheet manufacturers, and other ironmasters in the Staffordshire district. The works are under the personal supervision of Mr. Percy C. Gilchrist, one of the inventors.

There was a report upon the market that an inquiry was about for some 600 tons of sheets of 20 b.g. for a large home consumer. The correctness of the report could not be definitely ascertained, but the assumption was that the iron, if really needed, is probably for light constructive purposes.

Pig vendors report that consumers are at the present time overstocked, and that they will not, therefore, take deliveries in any large quantities. This being the case, vendors are not anxious to make new sales; the more so as there is no improvement in prices. Northampton pigs are 42s. 6d.; and Derbyshires, 43s.; native pigs are 57s. 6d. for all-mine hot blast; 45s. for part-mine; and 40s. to 37s. 6d. for cinder sorts.

Further evidence is forthcoming of the determination of our ironmasters not to continue manufacturing at a loss. Owing to the impossibility of securing orders in the present state of the trade at consistent prices, Messrs. W. A. Sparrow and T. Fowke, proprietors of the old-established Osier Bed Ironworks, Wolverhampton, have determined to cease working for the time being. They have therefore given the hands, numbering between 200 and 300, notice that after the 28th inst. the works will be closed until the state of trade justifies their re-opening. Best sheets and light plates are the principal product at these works. The firm's tin-plate department was closed about eighteen months ago. The works were established over fifty years ago. The only way to make a profit in the face of the present low prices is, in the opinion of the directors of the Pelsall Coal and Iron Company, to increase the output. To that object the operations of the company have of late been steadily directed. All the money that has been spent has been with the purpose of accomplishing that object. The company has acquired new coalfields and opened them up, and this has enabled them to sell for many months past a largely increased quantity of coal. The improvements and extensions which have been under execution for a long time past are now nearly completed. During the past three or four years they have spent £25,000 or £26,000 on the coal and water plant. The result of this enterprise, as exemplified in the operations of the year ending March last, has been the making of a profit of £7515, out of which a dividend of 5 per cent. per annum has been declared for the past half-year.

The mill hands at the ironworks are proceeding with the formation of a Millmen's Union.

Constructive engineers observe with interest that the Indian State Railways are inquiring for steelwork and ironwork for cantilevers of the Sukkur Bridge, 800ft. span. The hope is expressed that we shall have no repetition over this contract of the recent action of the Indian Department in placing contracts with continental manufacturers when our own yards are wanting work.

The slightly more satisfactory reports of the hardware makers concerning the export markets continue. A few of the Mediterranean countries are purchasing more freely, as are also certain South American and New Zealand consumers. The Cape keeps very quiet.

The demand for cultivating and edge tools for shipment is good, but the business is robbed of satisfaction by the lowness of rates. Hand-made horseshoes are in request from the Australian colonies, and on home account; but the competition of the machine-made shoe is increasing. Orders for agricultural iron fencing are slow, but wire netting manufacturers are well occupied for home and export.

Good profits continue to be made by Nettlefold's. For the year ending March last the net profit has been £76,330. From this it is proposed to pay a dividend of 6s. per share on the ordinary capital, 60s. per share on the deferred debentures, and 5s. per share on the preference capital; to place £25,000 to depreciation, and to carry forward £4400.

Traders in Birmingham and district are eagerly anticipating the reply of the President of the Board of Trade to the deputations that this afternoon—Thursday—will wait upon the right hon. gentleman at the offices of the department concerning the Railway Bill now before Parliament. The committee of the Birmingham and District Railway and Canal Rates' Association send a deputation who, while expressing their entire approval of the general scope of the measure, will strongly object to clauses 21, 24, and 25. These clauses bear on the power of appeals and terminals; and the latter are deemed especially obnoxious by manufacturers and other traders in the Midlands. The reasons for these objections are to be fully explained to Mr. Chamberlain. The attempt to induce the railway carriers to alter their regulations as to the carriage of smalls, according to weight, is now being joined in by the council to the Walsall Chamber of Commerce. All packages of less than 500 lb. weight are charged at a higher rate than less bulky packages. The Walsall Chamber desire a return to the limit fixed prior to 1877, say, 100 lb., which would, it is calculated, effect a reduction on an average of 6d. per package. It has this week been determined to memorialise the carriers on the subject.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The approaching close of the half-year, with the usual stock-takings, has a tendency to intensify the quiet tone which I have had to report in the iron trade of this district for some time past. There is a disposition on the part of consumers to hold back orders until after the turn of the present month, and as there is a prevailing belief in the continuance of low prices, transactions generally are more or less regulated by the conviction that there is no immediate necessity for buying beyond present requirements. But although there is nothing in the near future to justify any expectation of an upward movement in values, it is becoming evident that the limit is being reached for any further downward movement. Any really legitimate margin upon which prices could be materially reduced has, in fact, already disappeared; and although there are always some sellers who, under the pressure of circumstances, are compelled to meet the market to secure orders, there is a growing disposition rather to reduce the output than attempt to force business by any further lowering of prices.

There was only a quiet market at Manchester on Tuesday, with very little inquiry for either pig or manufactured iron. In the absence of any prospect of better prices being obtainable, makers were open to sell forward on the basis of the present low rates, but buyers appeared to be quite indifferent about giving out orders, and the general tone of the market was weak. Lancashire pig iron makers are not holding so firmly to their full list rates, and 43s., less 2½, would now be taken for forge and foundry qualities delivered equal to Manchester; but only a few small orders are being got. The business doing in district brands also continues very small, and Lincolnshire iron is being offered over the remainder of the year at 42s. 6d. to 43s., less 2½ for forge and foundry qualities delivered equal to Manchester. In outside brands a tolerably firm tone is being maintained, which is tending to check underselling in Scotch and Middlesbrough iron; but this is due rather to anticipations of a reduced output than to any actually increased demand.

In hematites there is still practically little or nothing doing. Quoted rates are nominally without change, but where any offers are made they are about 1s. per ton under the prices asked by makers.

The weight of new business coming forward in the finished iron trade continues very small. A few of the leading makers have their books pretty full for the present, but generally the new work being got is not sufficient to keep the forges on full time. In some cases where makers have been maintaining prices rather above the average market rates, there would be a disposition to give way if they saw any prospect of concessions stimulating business; but in the absence of any indication of such a result being attained, they prefer to hold on to their prices. With regard to prices generally, although here and there for immediate specification a little less would be taken, there is not much giving way, and for good qualities of bar iron delivered into this district makers, as a rule, are firm at £5 15s. per ton. There is some little underselling on the part of merchants, and common bars are to be bought at £5 12s. 6d. per ton delivered.

Ironfounders report rather more orders stirring, but they are mostly of a hand-to-mouth character, and there is not much work ahead. Extremely low prices still rule for all descriptions of foundry work, and heavy castings, such as columns and beams, can be got at from £5 to £5 10s. per ton delivered into Manchester. Pipe castings are also still offered here at extremely low figures, and ordinary qualities can be got at from £4 8s. to £4 12s. 6d. per ton according to section.

Most of the leading branches of the engineering trade in this district are being kept moderately well employed, but new work is scarcely coming in so fast as old orders run out. The falling off is, however, not sufficient to make itself as yet seriously felt. Locomotive builders are still pretty fully employed on old orders, but the new inquiries coming forward are reported to be only limited in weight. Tool-makers, except that some special branches are kept well employed, are not so busy as they were. Machinists, who have had a tolerably good run of orders recently, are, so far as the leading firms are concerned, still tolerably full of work.

The returns issued this month by the Amalgamated Society of Engineers, the Steam Engine Makers' Society, and the Ironfounders' Society, show a slight decrease in the number of members in receipt of out-of-work support, but it is so slight that practically the condition of employment may be said to remain stationary. The returns cannot be said to indicate any improvement in trade, the slightly lessened number of members out of work being attributable rather to the fact that men who were thrown out through the closing of establishments for the recent holidays have again been taken on. The returns generally of the Amalgamated Society of Engineers show but little variation from last month, any decrease in the number of unemployed being chiefly in the Lancashire district, and the average number of members in receipt of out-of-work support throughout all the branches is about 3 per cent. The reports as to the state of trade from the various Lancashire districts represent it as continuing moderate, and Bolton appears to be the only important centre in which there is any material falling off. The report of the Steam Engine Makers' Society, whilst recording a slight decrease in the number of out-of-work members, adds that the general tone of the branch returns does not justify the conclusion that there is any improvement in trade, or that the prospects are any more cheering than they have been for some time past. The most discouraging reports are from the marine engineering districts, whilst the long holidays for Whitsuntide, it is pointed out, testified to the limited orders in hand, or valuable machinery would not have had to remain idle for so long a period. The secretary of the Ironfounders' Society regrets that this month's report does not show any improvement in trade, the outlook pointing rather to still further depression. They were now in the middle of the year, when under ordinary circumstances trade should be in full activity, instead of which they had increased stagnation. However, they were glad to notice that their returns showed a slight decrease in the number on donation benefit, but this was so small that the position might be said to be pretty much the same as last month. By comparing, however, the same period with last year, they had now 785 members on the benefit, against 477 in June, 1883, and these figures spoke more forcibly than words could do.

The Manchester Association of Employers, Foremen, and Draughtsmen continues to make steady progress, and at the last half-yearly meeting on Saturday twelve new members were elected.

The coal trade generally is quiet. A few of the collieries are being kept working about five days, but the average does not exceed four days a week, and at many of the pits a considerable portion of the output is going into stock. All classes of round coal move off slowly; and although there is a fair demand for engine fuel, supplies continue ample for requirements. For special sales, or to clear away stocks, prices are cut extremely low, but the ordinary quoted rates are without material change, and at the pit mouth average 8s. 6d. to 9s. for best coal, 6s. 6d. to 7s. for seconds, 5s. 6d. to 6s. for common house coal, 5s. to 5s. 6d. for steam and forge coal, 4s. 6d. for burgy, 4s. to 4s. 3d. for best slack, 3s. 6d. to 3s. 9d. for good ordinary qualities, with common about 3s. 3d. per ton.

For shipment there is a moderate demand, but at very low prices, Lancashire steam coal averaging 7s. to 7s. 3d. per ton delivered at the Garston Docks, or the high level, Liverpool.

The recent arrival in Liverpool of several cargoes of gas coal from Australia has given rise to a good deal of comment, which has caused the matter to assume an importance it does not possess. The shipment of these cargoes can only be effected profitably when vessels are so absolutely short of freights that they have practically nothing else to carry, and the coal can consequently be exported to England at almost a nominal cost, but that a regular competing trade could be established is out of the question. The coal itself is, however, remarkable for its gas-producing properties; it is extremely light, and so full of gas, that to quote an expression I heard, it can almost be forced out by the pressure of the hands. The coal is, however, altogether useless for any other purpose; it does not make a particle of coke, and it has to be largely mixed with other fuel.

The wages question is again cropping up amongst the colliery proprietors in the West Lancashire district, and a proposed reduction was under consideration at a meeting held in Manchester on Tuesday. Nothing definite was, however, agreed to, and the difficulty seems to lie in securing combined action in the matter. Some of the colliery proprietors are, however, accumulating heavy stocks, evidently with the view of being prepared should any action that may be taken lead to a strike.

The special series of meetings in connection with the Manchester Geological Society, arranged to be held in Wigan during the past session, to meet the wishes of the large number of mining engineers in the above district who are members, was brought to a close by a meeting fixed for Friday last, but there was so small an attendance that an adjournment had to be agreed to. It is unfortunate that more interest is not taken in these meetings, as they might be made a very useful medium for discussing mining subjects of importance which are now so largely taken up by the society.

Barrow.—I have to report an unchanged condition of the hematite pig iron trade of this district, the slight improvement noticeable last week still continuing. The market is well attended and the demand is fairly well maintained, though the business doing is comparatively small. Home consumers are still very cautious in transactions, and the orders placed in makers' hands are restricted to more immediate wants. Foreign buyers appear to have mere confidence in makers, and some good contracts have been booked, especially on Russian account. The shipments have somewhat increased, but as the output of the district is considerable, stocks are heavy. Prices are quotably unchanged, 47s. 6d. per ton net at works representing mixed parcels of Bessemer iron. In the steel trade there is a little better activity, and a few orders have been booked principally on home account. These will keep the mills employed for some time. Steel rails are in demand, and there is a slight inquiry for merchant qualities. Wire is also in fair demand. Prices for rails remain at about 90s. per ton net at works prompt delivery. The shipbuilding industry of the district is in a very stagnant condition, and at present there are no signs of any improvement taking place. Engineers, boiler-makers, and the other minor departments of the steel and iron trades are but indifferently employed. Iron ore in slightly better demand at last week's rates. Shipping freights easier to obtain.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THOUGH the coal trade is undoubtedly quiet, it is interesting, as well as gratifying, to note that the business of the South Yorkshire collieries with Hull is larger than last year. Last month there was sent by water 50,728 tons, and by rail 64,944 tons, the total being an excess of 448 tons over the quantity sent for the corresponding period of last year. During the past five months the quantity sent was 506,192 tons, an increase of 11,688 tons over last year.

The Board of Trade returns for May do not show any particularly hopeful features as regards articles of Sheffield production. The values for the three past years come out thus:—May, 1882, £4,878,027; May, 1883, £4,836,991; May, 1884, £4,757,026. These figures apply to hardware and cutlery, iron and steel, lead, plate, and plated ware, telegraph wire, tin, zinc, steam engines, &c. The total decrease, it will be noted, is not large—£121,000 for last month as compared with £79,665 for the corresponding month of last year; but the dispiriting feature of these returns is their continuous decrease, and the fact that the falling off is chiefly in hardware and cutlery, and iron and steel, which more closely affect the Sheffield district. In hardware and cutlery, for example, the decline is £58,412 as compared with last year, and £67,295 as compared with 1882. The markets which show the most serious decline are Australia, India, Canada, Brazil, and the United States. The only markets which show an increase are France, Holland, and the Argentine Republic. Then there is a decline in iron and steel of no less than £187,477 as compared with May of last year, and £360,368 on the two years. Steel is again very discouraging, the value for last month being only £109,148, against £123,421 last year, and £208,555 two years ago.

It is satisfactory to observe that the strike at the pits belonging to the Stanton Coal and Iron Company has terminated. The men have decided to accept the terms offered by the employers. There are still several disputes outstanding in the Mansfield and other coal-fields, chiefly for advances in wages.

The improvement in the iron trade noted at Barrow in consequence of large purchases for Russia has not extended to this district. A singular state of things is reported from Wolverhampton, where, it is said, angles and plates are being delivered from Middlesbrough at, in some cases, 20s. per ton below Staffordshire prices.

The Yorkshire Steel and Iron Works, Penistone—one of the branch establishments of Messrs. Charles Cammell and Co.—were the scene on Thursday, the 5th inst., of a very serious accident. A converting vessel, containing eight tons of molten metal, was being lifted by the hydraulic machinery, when it suddenly tipped over, and the contents fell into the pit beneath, where there was a quantity of water. The result was a terrible explosion, which injured seven men and blew off the roof of the shop.

The shareholders of Messrs. C. Cammell and Co. paid their long-talked of visit to the Derwent Steel and Ironworks, Workington, their recently acquired property. The trip was a decided success, and the visitors left Workington with an impression that Mr. Wilson, the chairman of the company, had shown even more than his usual sagacity in his bold policy of transferring the export steel rail trade from the inland mills to the coast.

Mr. Ruston, who has just been elected Member for the City of Lincoln, in succession to the late Mr. J. Hinde Palmer, is the sole proprietor of the firm of Ruston, Proctor, and Co., manufacturers of steam thrashing machinery, Lincoln. He was at one time an apprentice in the employment of Messrs. George Wolstenholm and Son, Washington Cutlery Works, Sheffield. At the expiration of his apprenticeship he went into partnership with Messrs. Burton and Proctor at Lincoln. The business was greatly extended by his energy, and was ultimately acquired by Mr. Ruston, who has now about 1500 men in his employment, with branch establishments at Riga, Pesth, Milan, and elsewhere.

Several of the local landowners and their solicitors have had an interview at Sheffield, for the purpose of arranging terms to avoid opposition in the House of Lords to the Railway Bill. The engineers and solicitors of the Bill have also gone over the course of the new railway to settle various matters previous to the Bill coming before a Committee of the House of Lords, where it is expected to be taken on the 20th inst. There are now only two petitions against the Bill in the Lords—the Manchester, Sheffield, and Lincolnshire Railway Company and a local landlord, the Duke of Rutland. It is hoped that the opposition of his Grace may yet be averted.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE Cleveland pig iron trade is in a somewhat more hopeful condition than it has been for a long time. An increased amount of business has been done during the past week, and at the market held at Middlesbrough on Tuesday last the tone was cheerful, and recent prices were fully maintained. No. 3, g.m.b., is in demand for shipment abroad, and cannot be had for prompt delivery from makers outside the combination for less than 37s. per ton. The leading combined makers are obtaining as much as 37s. 6d. for what they have to dispose of. The demand for forge iron just keeps pace with the production, and the price is firm at 35s. 6d. per ton, that figure being freely given.

Messrs. Connal and Co.'s stock of Cleveland pig iron at Middlesbrough on Monday last was 58,299 tons, being a reduction of 288 tons for the week. At Glasgow, on the same day, their stock was 589,987 tons, or a decrease of 507 tons.

The shipments from the Tees have been fairly satisfactory during the past week. The total quantity of pig iron sent away this month up to Monday night was 40,146 tons, against 43,826 tons in the corresponding period of last month.

The outlook in the finished iron trade continues dull. The demand does not improve, but prices are somewhat firmer since the wages difficulty was arranged. Ship plates are offered at £5 to £5 2s. 6d. per ton, angles at £4 15s. to £4 17s. 6d., and common bars at £5 2s. 6d. to £5 5s., all free on trucks at manufacturers' works, cash 10th less 2½ per cent. discount.

Messrs. Bolckow, Vaughan, and Co.'s mills and forges at Witton Park are still idle. It is now a month since the works were in operation, and the distress amongst the unemployed ironworkers is very severe. Messrs. Dorman, Long, and Co., West Marsh Ironworks, are again in full operation, but only forty-five out of the 120 puddling furnaces at the Britannia Ironworks are at work.

It was reported at a meeting of the River Tyne Commission last week that 104 steamers, amounting to 85,337 tons burden, are lying idle on the Tyne. There are also sixteen sailing vessels laid up amounting to 10,245 tons burden. On May 3rd the number of idle vessels on the Tyne was eighty-one.

The committees of the Durham Coalowners' and Durham Miners' Federation Board agreed last week to re-establish for another two years the sliding scale that has governed the trade for the last two years.

The platers' helpers employed at the shipyards on the Wear have received notice of a reduction of 1s. 6d. per week, to take effect on and after July 10th.

Workshops and plant for a new shipyard are being erected at South Stockton by Messrs. Craig, Taylor, and Co. Some 500 to 600 workmen will be employed when the yard is in full operation. Mr. Craig was formerly a member of the firm of Edwards, Sons, and Craig, iron shipbuilders, South Shields.

The strike of engine-fitters at Sunderland still continues, and the men are maintained in idleness by the Amalgamated Society of Engineers. The matter concerns no one but themselves, as there are scarcely any marine engines under construction, and abundant labour is forthcoming wherever required. But the continuance of a strike under such hopeless conditions is a folly and absurdity apparent to all except those who are responsible for its conduct.

The West Cumberland Steel and Iron Company, of Workington, has announced its intention of stopping the whole of its works, except the smelting and the Siemens steel departments. It was two of the directors of this company, supported by one of their managers and a few of their friends, who recently waited upon Sir Thomas Farrer, of the Board of Trade Department, with a petition. Imbued with philanthropic sentiments, and deeply sympathising with Mr. Chamberlain in his efforts to protect the lives of her Majesty's subjects at sea, these gentlemen desired that Government influence should be used to cause steel, and not iron, to be used in future for the construction of merchant shipping. To effect this object a new and severer system of testing was to be imposed by the Board of Trade, as regards shipbuilding iron, which would entirely prevent successful competition with steel. The deputation obtained but little comfort from Sir Thomas Farrer, who did not appear to think that their new-born and excessive interest in the British sailor was wholly disinterested, and they were politely bowed out. The incident has afforded not a little amusement to those interested in shipbuilding in the North of England, and the stoppage of works referred to is supposed to be the natural sequel of the failure to stifle competition by a means as comical as it was improper.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow warrant market has been active during the past week, and a large quantity of pig iron has changed hands at an advance in prices. The expectation of some further curtailment in the production has been the main occasion for the improvement in quotations, and as this was a contingency which might or might not happen, the transactions have for the most part been of a speculative nature. It is not therefore likely that there will be a sustained upward movement of prices at present. The past week's shipments of pigs were 11,151 tons, against 13,255 in the corresponding week of 1883. Considerable orders are coming from Germany, Italy, and Russia, and while the reports called from New York as to the state of the market there are not satisfactory, there has been a fair quantity of iron shipped to the States of late. The Canadian demand is backward. In the course of the week the stock of pig iron in Messrs. Connal and Co.'s stores has decreased by about 600 tons. There are 95 furnaces in blast, as compared with 114 at this date last year.

A large business was done in the warrant market on Friday up to 41s. 4½d. cash. On Monday forenoon the market was strong at 41s. 4½d. to 41s. 6d. cash, the quotations in the afternoon being 41s. 4½d. to 41s. 6½d. and 41s. 5d. cash and 41s. 8½d. to 41s. 7d. one month. Business took place on Tuesday forenoon at 41s. 5d. to 41s. 4½d. and 41s. 6½d. cash, the quotations in the afternoon advancing to 41s. 7½d. cash and 41s. 9d. one month. Business was done on Wednesday up to 41s. 9d. cash, the price receding at the close to 41s. 6d. To-day—Thursday—transactions occurred from 41s. 4½d. to 41s. 5½d., closing at 41s. 4½d. cash.

The values of makers' iron are for the most part firm as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 51s. 3d.; No. 3, 49s. 6d.; Coltness, 56s. 6d. and 50s. 6d.; Langloan, 53s. and 51s.; Summerlee, 50s. 6d. and 46s. 6d.; Calder, 51s. 9d. and 46s. 6d.; Carnbroe, 50s. 6d. and 46s. 6d.; Clyde, 47s. 6d. and 45s.; Monkland, 43s. 3d. and 40s. 3d.; Quarter, 42s. 6d. and 40s. 3d.; Govan, at Broomielaw, 42s. 6d. and 40s. 3d.; Shotts, at Leith, 51s. 6d. and 51s.; Carron, at Grangemouth, 48s. (specially selected, 54s.) and 47s. 6d.; Kinneil, at Bo'ness, 44s. and 43s.; Glengarnock, at Ardrossan, 50s. and 43s. 6d.; Eglinton, 44s. 6d. and 41s.; Dalmellington, 47s. and 42s. 6d.

A further reduction has been made on the prices of malleable iron, the demand for which has not in any respect improved.

The total imports of Cleveland pig iron to date is 114,940 tons, which shows a decrease of 9200 tons as compared with the quantity received in the same period of last year.

The exports of iron manufactures from the Clyde in the past week embraced machinery to the value of £21,500, mostly locomotives and sugar-crushing plant; sewing machines, £2200; steel goods, £2000; and general iron manufactures, £37,100. The general engineering trades are fairly active, and ironfounders, as a rule, are still doing well.

In the coal trade of the Clyde basin there has not been quite so much business. The shipments at Glasgow have included 2620 tons to Bordeaux, 1800 to Alexandria, 1200 to Montreal, 650 to Buenos Ayres, 500 to Malaga, and smaller quantities elsewhere. At Troan the exports of coals in the week were 7663 tons, while 8590 tons were despatched from Ayr. The coalmasters have experienced little inconvenience in the Glasgow district from the action of the miners in restricting the output. Indeed, some masters are of opinion that, had it not been for the action of the men, the quotations of coals could by this time have fallen to a considerably lower level. There is no expectation, however, of the prices being improved, so as to admit of higher wages to the miners, unless there should come a very large and unlooked-for improvement in the demand.

As will be gathered from what is said above, the colliers of Lanarkshire are still working short time, but in no case has their action hitherto been productive of any pecuniary benefit to themselves.

The threatened general lock-out in Fifeshire has been arrested by the men abandoning their position they had taken up towards the masters, a position which could scarcely be defended. When the employers intimated that the state of trade would not admit of the men's demand of 15 per cent. increase of wages being conceded, the latter determined that they would work only four days a week. The special rules provide that the colliers shall work at least eleven days a fortnight, and on their refusal to obey these rules, about 2000 men were locked out. Perceiving that the masters were in earnest, the men gave way at the end of last week, and so for the present at least the dispute is at an end.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

A NEW local company, called the Railway and Domestic Electric Lighting Company, has been floated, and I see that several well-known names of ship and colliery owners, mining engineers and others, of Cardiff and Swansea, figure therein.

I referred some time ago to a new company—the Swansea Engineering and Dry Dock Company—and now I regret to add that one of the promoters, Mr. Young, of Cardiff, committed suicide this week.

Mountain Ash used to be notorious as the spring of most of the disaffection in the colliery districts. It was originated there, and spread, or died out, as the case would be. Now Caerphilly is coming to the front for this post of notoriety. The latest agitation there is on the subject of wages. The custom, it appears, at Caerphilly is to pay the colliers fortnightly, the owner retaining one week in hand. The men now claim to be paid weekly, three days' wages only being kept. Vigorous efforts are in action to bring about a change.

The staple trades are much about the same. A little more is being done in iron, and some large shipments have taken place, the make amounting to fully 10,000 tons, of which 3000 tons were for Montreal. This shipment was conveyed in that fine steamer the Lilburn Tower. Good cargoes of ore are coming in, and it is just possible that a change is at hand. The belief as to a coming "boom" is still uppermost. The English market for steel rails is favourable to those energetic actions of American speculators which they know so well how to bring to bear. Constant inquiries are coming to hand, and may result in business.

The coal shipments have in all cases regained their average, and Cardiff total of 140,000 tons, Newport 36,000, and Swansea 40,000 compare favourably with the total weekly shipments of coal before the holidays. At the same time there is not the high pressure existing which used to tax the utmost efforts of traffic managers and dock employés.

There has been a good deal of discussion in the Rhondda Valley in regard to the evidence given on the Barry Bill, and some amount of uneasiness has been awakened in finding that the great coal riches of that valley are not so unlimited.

The course to be taken in utilising the best coals from Perth to the sea would be to act as in a colliery. There, in working the coals, the collier follows the seam with his tram plates until the boundary is reached; so here the Taff could follow as long as coal could be won, and the traffic falling by natural gradients into the main line, would keep to its natural outlet, the Bute Docks. The evidence of Mr. D. Evans, Rhymney, Mr. Wm. Jones, Cyfarthfa, and Mr. Martin, Dowlais, has been to the point, and has been in strong support of the Bute opposition. The sooner the conflict is ended the better, but it seems a great pity that £100,000 should have been subtracted from the district and scattered to the winds, while the need is so great of institutions for relief and for old age. A collier of seventy is an ordinary spectacle, and a collier pension almost unknown.

Dowlais has met with another reverse. At the Dowlais Colliery, Bedlinog, a spark from the brake of the winding engine on Tuesday morning resulted in the complete destruction of the engine and engine house by fire, and the temporary imprisonment in the colliery of all the colliers. It appears that the accident occurred soon after the last batch of men had gone down, and in a very few minutes the rope was burnt through and the cage hurled to the bottom of the shaft. It was some time before the ventilating shaft could be put into sufficient order for the escape of the gas; but it was eventually done and not a life was lost. Mr. H. Martin acted throughout with great zeal and ability, but it will be a month before the colliery will be in working order again.

The Taff Vale directors have passed a resolution taking over the Treferig Valley Railway, and will pay the shareholders 4 per cent. per annum.

Tin-plates are in steady demand, and trade at Swansea in plates and patent fuel is good. The Swansea Harbour Trust cordially support Sir H. H. Vivian's movement for making Swansea a harbour of refuge. His great point of the saving to be effected by bunkering vessels at that port is much commended.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

*** It has come to our notice that some applicants of the Patent-office Sales Department, for Patent Specifications, have caused much unnecessary trouble and annoyance, both to themselves and to the Patent-office Officials, by giving the number of the page of* THE ENGINEER *at which the Specification they require is referred to, instead of giving the proper number of the Specification. The mistake has been made by looking at* THE ENGINEER *Index, and giving the numbers there found, which only refer to the pages, in place of turning to those pages and finding the numbers of the Specification.*

Applications for Letters Patent.

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

10th June, 1884.

8764. SMALL-ARM FORE-END, A. Jeffries, Birmingham.
8765. CONVERTIBLE BERTHS, J. M. Crawford, Lilybank.
8766. VELOCIPEDES, W. Morgan, Birmingham.
8767. FIXING GARNETT SAW TEETH, E. Wilkinson, Marsden.
8768. PULLEY BLOCKS, J. E. Carter, Halifax.
8769. GALVANIC BATTERIES, J. Enright, London.
8770. BEDSTEAD PILLARS, E. Hoskins, Birmingham.
8771. SENSITIVE PAPER for COPYING DRAWINGS, H. J. Shawcross, Liverpool.
8772. CABLE RAILWAYS, W. P. Thompson.—(*C. B. Fairchild, New York.*)
8773. PRESSING ENSILAGE, C. G. Johnson, Darlington.
8774. INDICATING the TRANSMISSION of POWER, A. Masson, London.
8775. TRAVELLERS used in SPINNING MACHINES, P. and J. Eadie, Paisley, and R. Eadie, Manchester.
8776. SYPHON STENCH TRAPS, J. Mangnall, Manchester.
8777. PRODUCING COLD, J. H. Johnson.—(*J. C. Rossi, New Jersey.*)
8778. HEATING APPARATUS, J. H. Johnson.—(*E. Körting, Hanover.*)
8779. WORKING ELECTRIC BELLS, J. H. Johnson.—(*P. G. Skrivanow, Paris.*)
8780. REVOLVING ENDLESS RAILWAY, T. Wright, Ulverston.
8781. CARBONS for ELECTRIC ARC LIGHTING, W. Hartnell, Leeds.
8782. OPENING BOTTLES, J. Coppard, London.
8783. OXIDE of IRON, T. Terrell, London.
8784. WHEELS, J. Cross, Wednesbury.
8785. ORNAMENTING TULLE, &c., A. C. Henderson.—(*Manger and Tisseyre, Lyons.*)
8786. FILTERING APPARATUS, H. B. Smith, Bath.
8787. FASTENING TRAM RAILS, A. E. Adlard, London.
8788. CLOCKS, F. Bosshardt.—(*M. Busse, Berlin.*)
8789. DIAMOND-POINTED HOOPS or FLAT IRON, H. Warrington, Stoke-upon-Trent.
8790. METALLIC PLATES for the SOLES of BOOTS, &c., F. C. Hawtin, London.
8791. DISINFECTING COMPOSITION, L. A. Groth.—(*V. Klein, Budapest.*)
8792. HORSESHOES, R. M. Skinner, London.
8793. TELEGRAPHIC RECEIVING INSTRUMENTS, J. S. Lamar, Georgia, U.S.
8794. DISCLOSING OBSTRUCTIONS to NAVIGATION, F. D. Torre, Baltimore, U.S.
8795. BRAKES for BICYCLES, G. S. and C. S. Hull, Chambersburgh, U.S.
8796. WINDING ELECTRO-MAGNETS, S. P. Thompson and P. Jolin, Bristol.
8797. MAGNETIC BALL CASTOR, H. Woodward, London.
8798. RETARDING and STOPPING RAILWAY, &c., VEHICLES, W. L. Wise.—(*J. Seubich, Dresden.*)
8799. FRICTIONAL COUPLINGS or CLUTCH-BOXES, T. G. Rhodes, Kirkstall.
8800. PREPARING AROMATIC COLOURING MATTERS, J. H. Loder, Netherlands.
8801. EDGINGS, W. Zehnter, Elberfeld, Germany.
8802. BALING PRESSES, H. J. Allison.—(*A. S. Robinson and A. Schell, Albany, New York, U.S.*)
8803. CONCENTRATING SULPHURIC ACID, P. Jensen.—(*A. Kuz, Berlin.*)
8804. PRODUCTION of CARBONATE of SODA, H. Gaskell, Woolton Wood, and F. Hurter, Widnes.
8805. TUBE CUTTER, T. McLaughlin, Bootle.
8806. COMBINING CERTAIN DIAZO COMPOUNDS with PHENOLS, &c., A. M. Clark.—(*Wirth and Co., Frankfort-on-the-Main.*)
8807. SKIPPING ROPES, E. Tomlinson and J. G. Strong, London.
8808. HORSE-HOE for HOEING TURNIPS, &c., A. Dyball and A. Payne, West Raynham.
8809. MACHINE-GUNS, T. Nordenfelt, London.
8810. DRESSING and SHAPING STONE, W. R. Lake.—(*J. W. Maloy, Somerville, U.S.*)
8811. TRANSPORTING CASH or GOODS from one PART to another PART of a SHOP, &c., W. R. Lake.—(*I. Bergé, Philadelphia, U.S.*)
8812. SPRING MOTOR APPARATUS, W. R. Lake.—(*G. F. Godley, Philadelphia, U.S.*)
8813. SUPPLYING AIR to LAMPS, W. R. Lake.—(*S. E. May, New York, U.S.*)
8814. SEAMING MACHINES, W. R. Lake.—(*E. Norton and J. G. Hodgson, Chicago, U.S.*)
8815. CUTTING BLANKS for SHEET-METAL CANS, W. R. Lake.—(*J. G. Hodgson, Chicago, U.S.*)
8816. CIGARS for MEDICINAL PURPOSES, P. Vermeulen.—(*J. F. Vermeulen, Brussels.*)
8817. ARMOUR PLATES, T. English, Hawley and A. Wilson, Sheffield.
8818. STEAM BOILERS, E. J. Curtin, Bristol.
8819. BORING, &c., MACHINE, O. Imray.—(*E. Helle, Hungary.*)
8820. DRAWING BOARDS, J. Sims, London.
8821. STRAIGHTENING ROUND BARS of METAL, H. J. Haddan.—(*L. Brightman, Youngstown, U.S.*)
8822. STRAIGHTENING ROUND BARS of METAL, H. J. Haddan.—(*L. Brightman, Youngstown, U.S.*)
8823. ANTI-FRICTION JOURNALS and BEARINGS, W. W. Smalley, Bound Brook, Somerset, U.S.
8824. PIANOS, W. Marshall, Malvern.
8825. PREVENTING INCRUSTATION in STEAM BOILERS, H. Hughes, Bristol.

11th June, 1884.

8826. NUT LOCKS for RAIL JOINTS, E. Berry.—(*A. Hebert, Montebello, and T. P. Butler, Montreal.*)
8827. LUBRICATOR, J. Granroth, Greenock.
8828. DOUBLE-RUDDERED STERN FRAME, W. Hewson, Hull.
8829. BOOK-REST, G. Davis, Bristol.
8830. PRESERVING ANIMAL SUBSTANCES used as FOOD, A. McDougall, Penrith.
8831. PIPE for SMOKING, H. Tait, Musselburgh.
8832. SAFETY LAMPS, A. J. Liversedge, Strandtown.
8833. FRAMEWORK, &c., of SHIPS, &c., F. Hewitt, Liverpool.
8834. TIMEPIECES, A. Schierwater, Liverpool.
8835. GAS-JET PROPULSION, T. Griffiths, Pembrokeshire.—*13th March*, 1884.
8836. UTILISING HAND BRAKES on COAL WAGONS, &c., T. Holmes, near Blaby.
8837. MECHANICAL MONEY-BOXES, W. Durant, Chapeltown, Yorkshire.
8838. CUTTING COAL, J. Lodge, Lydbrook, near Ross.
8839. DRYING FLUID, &c., G. F. Orange, Cornwall.
8840. USING, &c., the HEAT PRODUCED in FURNACES, G. F. Orange, Cornwall.
8841. CONSTRUCTING SHIPS' DAVITS, P. P. Bonnefoy, France.
8842. CONFECTIONERY, J. L. Collier, Rochdale.
8843. CLOSING BOTTLES, &c., T. H. Williams, London.
8844. WATER-CLOSET BASINS, S. H. Rowley, Swadlincote, Derbyshire.
8845. FIXING SHEET METAL COVERS to SHEET METAL, R. Clayton and G. Jones, near Bilston.
8846. LIVINGSTONE DOG CART, W. G. Wright and J. Hall, London.
8847. DOUBLING and TWISTING MACHINES, P. Hebbelynck, Belgium.
8848. JOINTS for BUILDINGS, &c., H. J. Haddan.—(*J. Proksch and H. Zwanziger, Vienna.*)
8849. TRICYCLES, E. R. Settle, London.
8850. TRICYCLES, R. Varty, London.
8851. TREATING ALCOHOLIC SPIRITS, R. R. Tatlock, Glasgow.
8852. UNCAPPING, &c., the LENSES of PHOTOGRAPHIC APPARATUS, F. W. Branson, Leeds.
8853. SOLES of BOOTS, &c., E. Pitt, Staffordshire.
8854. CUTTING FIREWOOD, T. Andrew, London.
8855. PAINTING, &c., the BOTTOMS and SIDES, of SHIPS, A. D. Spiers, London.
8856. VENTILATORS, J. M. Lamb, London.
8857. PRINTING, &c., TICKETS, T. King and R. Wilson, London.
8858. GUIDE RING for FISHING-RODS, W. Woodfield, Worcestershire.
8859. SPOOL for SEWING MACHINES, W. L. Wise.—(*A. Sontzoff, Russia.*)
8860. SUSPENDING C-SPRING CARRIAGES, S. Hart, London.
8861. ELECTRICAL INDICATING APPARATUS, R. L. Spicer.—(*E. W. Lloyd, H.M.S. Inflexible.*)
8862. PACKING CASES, &c., G. Lines, London.

12th June, 1884.

8863. HANGING, &c., CURTAINS, J. Turner, Cheshire.
8864. PLOUGH, &c., J. Wrigley, Levenshulme, and W. McG. Greaves, Manchester.
8865. REGULATING ELECTRIC ARC LAMPS, T. Cuttriss, Leeds.
8866. BICYCLES, &c., J. Cheshire, Birmingham.
8867. GASLIGHT IMPROVERS, J. Wilson, Dudley.
8868. FIXING HANDLES to CAST IRON PANS, &c., J. Kennedy and J. Newport, Glasgow.
8869. TREATING PRODUCTS OBTAINED in EXTRACTING AMMONIA from FURNACE GASES, G. Craig, Ayr.
8870. PACKING for STUFFING-BOXES, &c., J. G. Hughes, Liverpool.
8871. PREVENTING OVERFLOW of BATHS, &c., G. E. Coke, Nottingham.
8872. FURNACES, R. A. Wilson, Salford.
8873. FIRE BLOWER, W. Horsley, Leeds.
8874. EXTERNAL METALLIC RING PISTON, J. Ambler, Hull.
8875. SPIRAL-SPRING ALARM GUN, G. Smith, Erdington, near Birmingham.
8876. LOOKING-GLASSES, &c., J. A. Thompson, London.
8877. COMBINED FIRE-TUBE and WATER-TUBE, T. Genty, London.
8878. VENTILATION, C. W. Barnard, Belfast.
8879. FURNACES, &c., J. E. Walsh.—(*A. Ryex, Belgium.*)
8880. FRICTION COUPLINGS, G. G. M. Hardingham.—(*J. C. Bleeney, Newark, U.S.*)
8881. PRINTING FLOORCLOTHS, &c., J. Wright, Kirkcaldy.
8882. MULES for SPINNING, &c., J. Hodgkinson, S. Bamford, and J. Ranson, Preston.
8883. PREVENTING STUDS from FALLING OUT, J. R. McVoy, Yorkshire.
8884. EFFECTING AUTOMATICALLY the DISTANCE of the CARBONS in ARC LAMPS, W. Rowbotham, Woolwich.
8885. SELF-ACTING MULES for SPINNING, J. C. Mewburn.—(*P. Delebart-Mallet, France.*)
8886. WEIGHING MACHINES, A. Langdon, Lincolnshire.
8887. IMAGE STANDS, &c., R. Choinanus, Berlin.
8888. STRING INSTRUMENTS, H. J. Haddan.—(*J. M. Grob and K. A. Gütter, Germany.*)
8889. VEHICLE STAUNCHION, J. Daniell and J. A. Elstob, London.
8890. TREATMENT of SLAG, E. Capitaine.—(*M. Nahnsen, Germany.*)
8891. STEAM BOILERS, J. C. Jopling, Sunderland.
8892. PIPES and HOLDERS for SMOKING TOBACCO, J. Paris, Lowestoft.
8893. WATERPROOF MATERIAL for WEARING APPAREL, R. S. Moss, London.
8894. VALVE CLOSETS, T. W. Dawes, Brighton.
8895. BOBBINS, J. T. Davis, London.
8896. STEAM BOILERS or GENERATORS, T. and R. Stirling, Govan.
8897. EFFECTING CHANGES of an INTERIOR INDICATOR, J. P. Pieri, London.
8898. SECTIONAL FLOORS for MALTING HOUSES, &c., A. J. Goodfellow, Ware.
8899. VENTILATION of BUILDINGS, &c., C. Wenner, Switzerland.
8900. COATED METAL for ROOFING, &c., E. L. Sheldon, London.
8901. CURRENT REGULATING DEVICES for ELECTRIC LAMPS, S. F. Walker and F. G. Olliver, Cardiff.
8902. TURNING FOUR or MORE SIDED OBJECTS in WOOD, &c., W. S. Bemi, London.
8903. REVOLVING HARROWS, E. K. Stanford, Colchester, and E. Button, Stanway.
8904. WATER-WASTE PREVENTING, J. Main, London.
8905. BATTERIES and ACCUMULATORS, F. H. Varley, W. Beale, R. H. Padbury, and J. R. Shearer, London.
8906. REGULATION of CURRENTS in TELPHER, &c., MOTORS, F. Jenkin, Edinburgh.
8907. ELECTRICAL CONDUCTORS, J. H. Johnson.—(*H. Bigeon, Paris.*)
8908. PRIMARY VOLTAIC BATTERY, E. Tyer, Dalston.

13th June, 1884.

8909. TAKING-UP MOTION of WEAVING LOOMS, G. W. Rhodes, Hadfield.
8910. PRESERVE, &c., STANDS, J. Burley, Birmingham.
8911. CHECKING APPARATUS, R. Nelson, Manchester.
8912. ADJUSTABLE CONICAL BEARINGS, E. Holt, Radcliffe.
8913. PERAMBULATOR FASTENER, S. Broadbent, Stretford.
8914. FORGE, W. K. Fulleylove, Rugby.
8915. CHECKING CASH RECEIPTS, &c., A. J. Johnston, Liverpool.
8916. MAKING BEVERAGES from CLOVER, J. Walker, Leeds.
8917. BILLIARD CUE, A. L. Adey, Edinburgh.
8918. AUTOMATIC TELEGRAPH INSTRUCTOR, C. Kahn, Liverpool.
8919. FLUE MOUTHS, T. F. May, Liverpool.
8920. HARNESS SHAFT TUGS, S. E. Davies, Liverpool.
8921. PORTABLE SAFETY ELECTRIC LAMP, E. T. Boston, Bristol.
8922. FOLDING COTS, &c., E. Hoskins, Birmingham.
8923. TRUSSES, W. Pearce, Cardiff.
8924. OPENING SLUICE VALVES and COCKS, J. Beck and M. Truelove, London.
8925. FURNACE BAR, S. R. Smyth, London.
8926. RAILWAY RAILS, A. E. Adlard, London.
8927. SLIDING WINDOW SASHES, T. Tobitt, London.
8928. SEWING MACHINES, F. Simmons, London.
8929. COMBINED PORTABLE TRAVELLING SCAFFOLD and CONCRETE ELEVATOR, F. West, Lewisham.
8930. AIR-TIGHT BIN, J. T. Richardson, Hampstead.
8931. SPRAYING APPARATUS, R. Schomburg, London.
8932. BREAKFAST CAN, W. Preston and C. Molsom, Kirton.
8933. PICTURE FRAMES, H. J. Haddan.—(*A. Runge, Leipzig.*)
8934. OBTAINING CHLORINE from CHLORIDE of CALCIUM, E. Edwards.—(*C. Taquet, France.*)
8935. SIZING MACHINES, T. Singleton, Over Darwen.
8936. ENGINE GOVERNORS, J. Tangye, Illogan.
8937. TRICYCLES, T. Shakespear, Birmingham.
8938. FLYING TARGETS, A. H. Hebbard, U.S.
8939. BOATS and OARS, A. J. Boult.—(*M. Davis, U.S.*)
8940. SHUTTLE SEWING MACHINES, S. Keats, near Stoke-upon-Trent.
8941. SHUTTLE SEWING MACHINES, S. Keats, near Stoke-upon-Trent.
8942. BOTTLES, J. Booth, New Basford.—*13th March*, 1884.
8943. FLOORING, S. Bivort, Belgium.
8944. REAPING and MOWING MACHINES, L. A. Couteau, France.
8945. TRUSS PADS, J. Arnold, London.
8946. SPEED INDICATORS, W. H. Douglas, Stourbridge.
8947. LOWERING BOATS, A. G. Brookes.—(*J. S. de B. Yelloly, West Indies.*)
8948. BUTTON FASTENINGS for CRAVATS, P. M. Salomon, Weissensee-Berlin.
8949. CONVERTING RECIPROCATIVE into ROTATIVE MOTION, M. Household and R. Caswell, Streatham.
8950. GAS STOVES, R. George, London.
8951. TICKETS, B. J. B. Mills.—(*P. R. Moréon and L. J. Debat, Lyons.*)
8952. PISTON METERS, A. Goodwin, jun., London.

14th June, 1884.

8953. PAPER FASTENERS, J. Whipp, Rochdale.
8954. THIMBLES, C. Horner, Halifax.
8955. FOLDING PAPER, R. Cundall, Thornton.
8956. VEHICLES, J. McQueen and W. H. Carmont, Manchester.
8957. BILLIARD TABLES, E. Bennett, London.
8958. STEAM BOILERS, A. Turnbull, Glasgow.
8959. GRAND PIANOS, T. Doddrell, Slough.
8960. GAS ENGINE CYLINDERS, W. Ainsworth, Penrith.
8961. WATER CIRCULATING PIPES, W. F. Simpson, Manchester.
8962. RECEIVING INSTRUMENTS, W. P. Thompson.—(*S. D. Field, New York.*)
8963. SHIRTS and CUFFS, R. H. Baker, Liverpool.
8964. FOLDING PERAMBULATOR and CHAIR, J. Pierce, Herne Hill.
8965. CLOSING BOTTLES, J. P. Donovan, Sheffield.
8966. GATES, W. P. Dimes, Oldstone.
8967. PIPE JOINTS, W. Richardson, Mansfield.
8968. PIANO ACTIONS, D. F. Downing, Woolwich.
8969. STORING AIR, &c., A. W. L. Reddie.—(*Schreiber and Co., Vienna.*)
8970. OIL LAMPS, A. Reddie.—(*Schreiber & Co., Vienna.*)
8971. VAGINAL APPLIANCE, H. S. Reynolds, London.
8972. CLEANING SHIPS' BOTTOMS, A. Spiers, Glasgow.
8973. FIRE EXTINGUISHING, E. P. Alexander.—(*C. H. Royce, Chicago, U.S.*)
8974. STEAM STREET CARS, A. M. Clark.—(*F. G. Wheeler, New York.*)
8975. UTILISING SMOKE, &c., A. M. Clark.—(*La Société Berlier et Lemarquand, Paris.*)
8976. CIGARETTE MACHINES, R. W. Page, London.
8977. APPARATUS for REGULATING the TENSION of the WARP BEAM EMPLOYED in LOOMS for WEAVING, R. Lightbrown and R. T. Gillibrand, Darwen.
8978. CASES for WATCHES, T. Wallen and J. Linnett, Coventry, and E. Gonty, Leicester.
8979. STEAM CYLINDERS, T. Willdigg and W. J. Brett, Coventry.
8980. TRICYCLES, R. S. Wheels, Coventry.
8981. IRON-WREST for PIANOS, K. Otto and T. Weidenslaufer, Berlin.
8982. CARRIAGE SHAFTS, R. J. B. Mills.—(*P. D. Lacour, France.*)
8983. TUBULAR LANTERNS, J. H. Stone, Hamilton, Ontario.
8984. OVENS for BAKING, &c., J. Hawley and J. Williams, London.
8985. BLADES of SCULLS, &c., W. J. Sage, London.
8986. VALVES, G. F. Busbridge and J. H. Turvey, East Malling.
8987. RACKET or TENNIS BATS, H. Yeldham, London.
8988. FASTENER for BRACELETS, F. N. Cummings, Cheltenham.
8989. FUMIGATING, &c., C. Groom, London.
8990. ELECTRIC TELEGRAPH, W. E. Gedge.—(*J. Kölzer, Germany.*)
8991. SCREENS for SIFTING CEMENT, A. Glover, Swanscombe.
8992. SPINNING MACHINERY, H. H. Lake.—(*E. Eldriege, Rhode Island, U.S.*)
8993. CRUSHING LIME, &c., H. H. Lake.—(*La Société Bertet et Sisteron, Paris.*)

16th June, 1884.

8994. MOULDING TOOTHED WHEELS, J. Whittaker, Oldham.
8995. PRESERVING MILK, D. Ker, London.
8996. METALLIC ROLLERS, J. Whitley, Leeds.
8997. PLASTIC CLAY SLABS, TILES, &c., O. Gibbons, Ironbridge.
8998. ENABLING PERSONS to RECORD VOTES SECRETLY, J. D. Kelly, Mullingar.
8999. HOLDERS for INCANDESCENT LAMPS, J. H. Greenhill, Belfast.
9000. ELECTRO-DEPOSITION of IRIDIUM on ROLLERS, &c., W. A. Carlyle, Birmingham.
9001. GAS and CALORIC ENGINES, H. Guthrie, Longsight.
9002. LOOMS for WEAVING, D. Bailey, B. Berry, S. Stead, and A. Gomersall, Halifax.
9003. SECURING THATCH on RICKS, &c., T. B. Burns, Camelford.
9004. BALL COUPLING, T. Widdowson and G. Renshaw, Sheffield.
9005. CRIB BITING COLLAR, J. Meyer, Paris.
9006. KITCHEN RANGES, &c., J. Adair, Waterford.
9007. PREVENTING ACCIDENTS in ROPE DRIVING, R. Hitchin and T. Richmond, Burnley.
9008. PLATE or LEAF SPRINGS, G. W. Willford, Sheffield.
9009. FLEXIBLE TUBES, M. Bauer.—(*P. Sorgue, Paris.*)
9010. SEWING MACHINES, J. H. Johnson.—(*M. Gritzner, Baden.*)
9011. MALTING, J. Flinn, Bishop's Stortford.
9012. SOAP, W. Rödiger, Germany.
9013. LEADING BACK EXHAUST STEAM to the BOILER, L. Crusius, Germany.
9014. DISINFECTING CLOTHES, M. Bauer.—(*O. Schimmel, Saxony.*)
9015. SPRING BARRELS for JEWEL CASES, S. Wootton, London.
9016. VEGETABLE IVORY BUTTONS, E. Berman, London.
9017. BRAKING RAILWAY TRAINS, A. Stewart, Largs.
9018. FIREPROOF BLOCKS, C. Toope, London.—*6th May*, 1884.
9019. BUTTONS, P. Courcel, Paris.
9020. STAY BUSKS, C. Libron, Paris.
9021. SHIP'S PUMP, T. Sloane, London.
9022. PREVENTING EXTRACTION of COINS from MONEY-BOXES, T. Whetstone, London.
9023. FIRE-ESCAPES, P. Jensen.—(*P. Schmahl, Germany.*)
9024. BOOTS and SHOES, T. Franks, Northampton.
9025. DECORATIVE COMPOUNDS for FABRICS, S. Loewenthal, London.
9026. PRODUCING from PHOTOGRAPHIC NEGATIVES BLOCKS for TYPOGRAPHIC SURFACE PRINTING, H. Gardner.—(*G. Sutherland, Adelaide.*)
9027. TANNING HIDES, &c., E. Hasler.—(*W. Nicholson, Sheffield.*)
9028. DOWN-CAST VENTILATORS, W. Lord, Middlesbrough.
9029. FLOATING DRY DOCKS, A. Taylor, Newcastle-upon-Tyne.
9030. LAMPS, P. A. Bayle, Paris.
9031. GLASS LAMP CHIMNEYS, P. A. Bayle, Paris.
9032. INDIA-RUBBER HOSE, I. B. Harris, Edinburgh.
9033. LIGHTING GAS AUTOMATICALLY, T. Caink, Leigh.
9034. FEED GEAR, P. P. Huré, Paris.
9035. TUBE EXPANDERS, P. P. Huré, Paris.
9036. PORTABLE FORGES and BLOWERS, R. R. Gubbins, New Cross.
9037. GRINDING MILLS, R. A. Lister and G. S. Richmond, Dursley.
9038. SUPPORTING BOOKS or SHEETS of MUSIC, M. Reid, London.
9039. LOOMS, A. M. Clark.—(*Wirth and Co., Frankfort-on-the-Main.*)

ABSTRACTS OF SPECIFICATIONS.

Prepared by ourselves expressly for THE ENGINEER *at the office of Her Majesty's Commissioners of Patents.*

3404. APPARATUS FOR LOADING VESSELS FROM LIGHTERS, *T. E. Heath, Northlands, Glamorgan.—10th July, 1883.—(Not proceeded with.)* 4d.

Relates to the construction of a shoot and apparatus connected therewith.

4574. CRUCIBLES, &c., *J. E. Bott, Manchester.—25th September, 1883.—(Void.)* 4d.

Consists in the construction of crucibles so that large quantities of metal may be melted, refined, or converted therein and poured therefrom directly into moulds without the use of ladles and without tilting the vessel.

4681. GAS PRODUCERS, &c., *J. E. Bott, Manchester.—2nd October, 1883.—(Void.)* 4d.

Relates mainly to the manner of admitting the air necessary for complete combustion of the fuel undergoing destructive distillation in gas producers, and in fuel-supplying devices and apparatus for the same.

4782. TELEGRAPHY, *S. Pitt, Sutton, Surrey.—9th October, 1883.—(A communication from P. B. Delany, New York, U.S.)* 10d.

This relates to a system of duplex telegraphy, in which the usual balanced circuits are dispensed with, and which permits of two messages being simultaneously transmitted in the same or opposite directions. This is accomplished by means of continuously rapidly operated circuit breakers and an arrangement of tuning forks connected with the main line at each station. The invention further relates to a sounder and the method of working the same.

4852. FILLING, REGULATING THE QUANTITY, AND COMPRESSING PACKETS OF POWDERED SUBSTANCES, *T. Davis, West Bromwich.—11th October, 1883.* 6d.

Relates to the general construction of the combined apparatus.

4869. POROUS VESSELS FOR THE PROPAGATION OF CERTAIN KINDS OF GRASSES AND THE LIKE FROM SEED, *A. G. Biffo and G. Dionisio, London.—12th October, 1883.—(Not proceeded with.)* 2d.

The composition consists of terra-cotta of the peculiar kind obtainable in the environs of Turin and hard wood sawdust.

4906. CENTRIFUGAL MACHINES APPLICABLE FOR BOLTING FLOUR, DUSTING OR FINISHING BRAN OR SHORTS, SCALPING THE FINER BREAKS FROM ROLLS OR OTHER LIKE WORK, *E. Fiechter, Liverpool.—15th October, 1883.—(A communication from L. B. Fiechter, Minneapolis, U.S.)* 6d.

Relates to improvements in the general construction of the machine and to the employment of a tension wheel; the counterbalancing of the beaters by adjustable balls or weights arranged on three points on the spider; and internal drift checking discs.

4946. VACUUM PUMPS, *W. H. Cullen, London.—17th October, 1883.* 4d.

The inventor claims in combination with a compound vacuum pump, a steam ejector applied to exhaust from the discharge of the second pump.

5014. MANUFACTURE OF ENVELOPES, &c., *W. E. Walmsley, Salford.—22nd October, 1883.* 10d.

Consists, First, of mechanism for gumming the sealed flaps of envelope blanks, and laying them out to dry; Secondly, of mechanism for gumming, printing, or embossing, folding, and packing the same, the whole of the mechanism being embodied in a single machine.

5025. CHECKING THE VISITS OF WATCHMEN TO PARTS OF BUILDINGS, &c., *J. W. Fletcher, Stockport.—23rd October, 1883.* 6d.

The workman completes an electrical circuit at each intermediate place he visits; this records the time of his visit on a band of paper carried by the drum of a suitable clock.

5051. PROPELLERS, *B. W. Maughan and S. D. Waddy, London.—24th October, 1883.* 6d.

Each blade is made of such a transverse section that its acting surface—that is to say, the surface which, in the act of propulsion, exerts pressure on the air or water—consists of two or more convex portions, which may be segments of a circle or of an ellipse or other curved figure.

5053. PRESERVING MILK, BEER, &c., *O. E. Pohl, Liverpool.—24th October, 1883.* 6d.

Consists, First, in preparing the bottles or receptacles by closing or stopping the mouths or orifices of the same before they are annealed by a mineral fibre, such as asbestos; Secondly, in filling the bottles or receptacles so prepared with milk or other liquid, with exclusion of air as far as possible.

5083. TOBACCO PIPES, *W. A. Ross and H. Lawson, London.—25th October, 1883.* 6d.

The pipe is provided with a chamber within which is placed sponge or other similar absorbent filtering material.

5092. MECHANISM FOR CROSS-CUTTING, SEPARATING, AND PACKING TICKETS, &c., *J. M. Black, London.—26th October, 1883.* 6d.

Consists in the construction, arrangement, and adaptation to revolving blocks of movable and fixed cutters, to be employed for cutting or severing from a continuous length or web of paper, cardboard, or the like, pieces of a uniform length, representing tickets, cheques, or labels.

5102. STOVES, &c., *G. Daves, Manchester.—27th October, 1883.—(A communication from F. Jackson, San Francisco.)* 6d.

Consists of an enclosed stove for general cooking purposes, comprising principally a fire-place, ashpit, flues, and oven, all enclosed in a suitable case fitted with a chimney or smoke pipe, and readily portable.

5109. GENERATION, STORAGE, REGULATION, DISTRIBUTION, &c., OF ELECTRICITY, *J. S. Williams, Riverton, New York, U.S.—27th October, 1883.* 5s. 2d.

This voluminous specification contains 124 pages of subject matter and 14 sheets of drawings, and relates to "the generation, storage, distribution, regulation, measurement, and utilisation of electricity, and apparatus or means therefor." Judging from the drawings only, the points of novelty appear to be a motor, a dynamo-electric generator, secondary batteries, and the application of secondary batteries, and a motor, to the propelling of ships. The inventor refers to fourteen previous specifications.

5112. VENTILATORS FOR SHIPS, &c., *J. W. Gibbs, Liverpool.—29th October, 1883.* 6d.

Relates to improvements on patent No. 3515, of 1881, the object being to adapt it to upcast ventilating also. The inventor uses, besides the holes described in former patent to let the drip out, openings fitted with valves, with weighted levers inside the ventilator.

5113. GAS ENGINES, *H. C. Bull, Liverpool.—29th October, 1883.* 8d.

Relates partly to the combination in a cylinder of a primary power piston and secondary piston, which latter is worked by a cam, and whereby the combustible charge is drawn into the cylinder, and the products of combustion are expelled, and the combustible charge is compressed and forced between itself and the primary power piston for ignition.

5117. PIPE OR TUBE, *J. Gaskell and G. G. Exton, Chippenham.—29th October, 1883.* 6d.

The pipe or tube is constructed with folded or interlocked longitudinal joint or joints, the folds, or folds and strips, forming such folded or interlocked longitudinal joint or joints being welded together.

5130. FASTENINGS FOR COVERS OR CASES OF UMBRELLAS, &c., *E. G. Brewer, London.—29th October, 1883.* 4d.

Relates to the employment of a spring consisting of one or of several branches contained in a slide or sheath applied to the upper part of covers or cases for umbrellas, &c.

5131. SEWING MACHINE, *W. F. Thomas, London.—29th October, 1883.* 6d.

Relates to improvements in the general construction and arrangement of sewing machines, particularly adapted for heavy work, such as sewing leather.

5141. TELEPHONES, *W. Gillett, Flushing, N.Y., U.S.—30th October, 1883.* 6d.

The diaphragm has fixed to it a concave disc, and so communicates its motion to a series of pins, each of which makes independent connection with an induction coil, each in turn provided with its own separate battery. The whole of the batteries are connected together to the one line wire. The diaphragm is held in place by an annular bead on the face-piece and a suitable surface on the adjacent portion of the instrument, the sharply-defined edges contributing to the clearness of the sound.

5142. MANUFACTURING LIGHT ESSENCES BY THE DISTILLATION OF COAL, &c., *N. A. Hélous, Paris.*—30th *October*, 1883.—(*Not proceeded with.*) 4*d*.

The process is based on the rational and permanent production of acetylene. The result is obtained by the intervention of three influences acting simultaneously. (1) A fixed temperature never exceeding dull red in the retorts. (2) The permanent action of a current of gas and steam, previously superheated and led into the retorts during the whole time of the distillation. (3) The influence of a mean pressure of a fifth of an atmosphere maintained in the retorts by means of a pressure regulator arranged at the series of barrels.

5146. STOPPING OF WOOL-COMBING MACHINES, *H. Priestman and F. K. Adcock, Bradford.*—30th *October*, 1883.—(*Not proceeded with.*) 2*d*.

The formation of a "lap" around the drawing-off rollers brings into operation an electro-magnet, whose armature releases the stop rod.

5147. PREVENTING THE POLLUTION OF RIVERS, *T. D. Harries, Aberystwith.*—30th *October*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to the employment of reservoirs, each of sufficient capacity to contain the polluted water from one day's operations in the factory.

5148. PRODUCTION OF PEROXIDE OF HYDROGEN, *F. C. Glaser, Berlin.*—30th *October*, 1883.—(*A communication from M. Traube, Breslau.*—(*Not proceeded with.*) 4*d*.

Relates to improvements in the general process.

5151. TRANSMISSION OF INTELLIGIBLE SIGNALS BY ELECTRICITY, *G. A. Cassagnes, Paris.*—30th *October*, 1883. 10*d*.

This relates to a combination of the quadruplex system with a stenographic system, so as to permit of the transmission and printing by electricity of stenographic signs. It is also stated that a telephone can be applied to the ear "with proper appliances," so as to enable the hearer to print the message on a band of paper.

5153. ELECTRIC CLOCKS, *S. Schisgall, St. Petersburg.*—30th *October*, 1883. 6*d*.

The mechanism consists of two wheels, an arrangement of springs, a commutator, and the pendulum, the oscillations of the latter being produced by an electro-magnet alternately magnetised and demagnetised automatically by the action of the clockwork.

5154. OBTAINING INCISED OR RAISED DESIGNS ON THE FLAT OR OTHER SURFACES OF STEEL, &c., *J. Brown, London.*—30th *October*, 1883.—(*Not proceeded with.*) 2*d*.

The print or design is obtained in a bitumen varnish, and is then transferred to the plate, which is then submitted to the action of acids or an electric battery.

5155. GAS STOVES, *E. P. Alexander, London.*—30th *October*, 1883.—(*A communication from J. G. Dupuy, Canderau, France.*)—(*Not proceeded with.*) 2*d*.

Relates to an arrangement for controlling the supply of gas.

5156. FERTILISING MANURE, *E. Edwards, London.*—30th *October*, 1883.—(*A communication from A. Chénard, Paris.*)—(*Not proceeded with.*) 2*d*.

Relates to a method of treating coal tar and combining it with lime and phosphate of lime, so that it can be used as a manure in a state of powder without affecting its natural qualities.

5157. SAWS, *J. H. Johnson, London.*—30th *October*, 1883.—(*A communication from F. A. Tremé-Becker, Paris.*)—(*Not proceeded with.*) 2*d*.

Consists in combining saws with means for planing or smoothing the surface of the wood.

5158. INCANDESCENT ELECTRIC LAMPS, &c., *A. Swan, Gateshead.*—30th *October*, 1883. 6*d*.

The neck of the globe is formed with projections which engage with suitable springs attached to the holder. The terminal wires project, and are held by springs connected through the holder with the conductors. The holder may be formed in two parts, which are locked together with a bayonet-like joint. The holder is also modified so as to take a lamp having its terminal wires projecting as loops from the sides of the neck.

5159. INCANDESCENT ELECTRIC LAMPS, *J. Swinburne, Gateshead.*—30th *October*, 1883.—(*Not proceeded with.*) 2*d*.

The filaments are made from cotton acted on by strong nitric acid, then washed with water, and afterwards boiled in a solution of potassium. The joints are made by a carbonaceous cement.

5161. MEASURING AND CONTROLLING THE FLOW OF LIQUIDS, *F. B. Hill, London.*—30th *October*, 1883. 6*d*.

Relates partly to the employment of a valve combined with a float, and so arranged that the said valve will be opened by the head of liquid in the measuring chamber or tank when the proper quantity of liquid has been supplied thereto, and will be held up by the buoyancy of its float until the said measuring chamber or tank is empty, or nearly so, and will then be closed by gravity.

5162. MECHANICAL TOYS, *J. M. Richards, London.*—30th *October*, 1883.—(*A communication from J. D. O'Donoghue, Brooklyn.*)—(*Not proceeded with.*) 2*d*.

Relates to the construction of a toy racecourse.

5163. REVOLVING FIRE-ARMS, *W. W. Colley, London.*—30th *October*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to a self-cocking revolving gun for military or sporting purposes, the gun being cocked, fired, and revolved by one and the same means.

5164. RAILWAY TIPPING WAGONS, *A. M. Clark, London.*—30th *October*, 1883.—(*A communication from W. Fallon, Newbury, U.S.*)—(*Not proceeded with.*) 2*d*.

Relates to improvements in tip wagons or trucks, which are constructed with a platform composed of two wings of equal dimensions, hinged together at their junctions, and resting on the cap-sills.

5165. SECONDARY BATTERIES, *I. L. Pulvermacher, London.*—30th *October*, 1883.—(*Not proceeded with.*) 2*d*.

The electrodes are made by spinning lead wire on a cord composed of platinum, copper, and lead wires, the covered cord being then wound about a perforated sheet of lead. The coil elements are preferably arranged in a cylindrical vessel containing the electrolytic liquid.

5166. GALVANIC BATTERIES, *I. L. Pulvermacher, London.*—30th *October*, 1883.—(*Not proceeded with.*) 2*d*.

The element described in the previous specification is, after carbonising the cotton coating of the compound cord, used in conjunction with a zinc rod to form a battery.

5169. LIFE RAFTS, *A. H. Williams, London.*—31st *October*, 1883.—(*Not proceeded with.*) 2*d*.

Consists in constructing the raft in three or more portions, consisting of air-tight chambers or compartments, which are so hinged or connected together that when closed up they form a seat, and when opened out they form a raft, the said portions being retained or secured in their open position by suitable hinged joints, and by bars pivotted or hinged at one end to one of the compartments and held in place, and secured to the other compartments by fastening contrivances.

5171. DIFFERENTIAL DRIVING GEAR FOR VELOCIPEDES, *C. V. Boys, London.*—31st *October*, 1883. 6*d*.

Consists in the construction of differential driving gear, wherein balls engaged in recesses of a driving wheel are pressed by the slope of three recesses into a V groove formed between the coned edges of discs attached to the two differentially driven axles.

5172. LOOMS, *J. S. Hargreaves, Ashton-under-Lyne.*—31st *October*, 1883. 6*d*.

Relates to the particular construction of the dobby and apparatus for actuating the same.

5174. MOVING THE POINTS OF TRAMWAYS, *E. C. Urry, London.*—31st *October*, 1883. 6*d*.

The object is to enable the driver or other person in charge of a tram-car to move the points at a junction just before the wheels of the car reach them so as to ensure the car running in the right groove or direction, and the invention essentially consists in the employment of a rail laid parallel with the rails of the permanent way just before the junction is reached, the said rail being connected by mechanism with the points, so that when depressed by a tappet or device on the car it moves the points and ensures that the car will run in the right groove or direction.

5176. MOUNTING OF CARRIAGE BODIES, *H. A. G. Somerset (Lord A. Somerset), Badminton, and F. Mulliner, London.*—31st *October*, 1883. 6*d*.

The inventors fit to the front and back frames of the underwork transverse springs in connection with elbow springs from the body for supporting the leather braces on which the body of the carriage rests after the manner of the hind part of a tilbury.

5177. ARMATURES FOR ELECTRICAL APPARATUS, *F. C. Glaser, Berlin.*—31st *October*, 1883.—(*A communication from K. Luedtke and G. and A. I. Gravier, Warsaw.*)—(*Not proceeded with.*) 2*d*.

The armature is constructed by arranging a number of elements together, each constructed by sprinkling iron filings on a sheet of paper held over a magnetic field.

5178. COLOUR BOXES, *T. Foxall, London.*—31st *October*, 1883. 6*d*.

Relates to the means for securely holding the colour pans in place.

5180. ELECTRIC BURGLAR OR FIRE ALARM, *F. J. Harrison, London.*—31st *October*, 1883. 6*d*.

This consists of a portfire charged with a material giving a powerful light, and fitted with detonators. The detonator is electrically connected with all the doors and windows of the house, and these are so arranged as to complete the circuit on any one of them being opened. When used as a fire alarm, a coloured fire composition (red preferably) is used.

5181. FLUID-PRESSURE ENGINES, &c., *H. Coppinger, Cork.*—31st *October*, 1883. 6*d*.

Consists in a rotary apparatus applicable as a motor or pump, or meter, the construction with a sliding abutment or abutments in a cylinder of a rotatable part resembling in form two half turns of a helical screw thread respectively right-handed and left-handed, united at their radial edges in such a way as to form one piece, having a circular circumference surrounding an axis common to both halves.

5182. STOPPERS FOR BOTTLES, &c., *W. J. Brewer, London.*—31st *October*, 1883.—(*Not proceeded with.*) 2*d*.

The stopper is formed of a cup and a plug.

5184. NAILING MACHINES, *W. F. Watson, London.*—31st *October*, 1883.—(*A communication from J. H. Swift, Brooklyn.*)—(*Not proceeded with.*) 4*d*.

Relates to machines for feeding nails to the work into which they are to be driven and for driving the said nails.

5185. MAKING AND ATTACHING THE HEELS OF BOOTS AND SHOES, *H. A. Oldershaw, Leicester.*—31st *October*, 1883. 6*d*.

Relates to the construction of a machine in which the two processes of making or building up the heel, and afterwards attaching the same to the boot or shoe, are performed.

5186. MACHINES FOR SEWING CARPETS, *W. R. Lake, London.*—31st *October*, 1883.—(*A communication from A. Neustadt, San Francisco.*)—(*Not proceeded with.*) 2*d*.

The chief object is to provide improved devices for holding the edges of the carpet as it is being sewn, and for causing the entire machine to travel along the carpet in the manner necessary for permitting the stitches to be made in a proper manner to form the seam.

5187. APPARATUS FOR DRILLING OR CUTTING HOLES IN METAL, *R. K. Jones, Birkenhead.*—1st *November*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to improvements on patent 2190, A.D. 1883, and consists partly in means of obtaining rapid motion of the drill stock.

5188. MINERS' SAFETY LAMPS, *T. Thomas, Ystradyfodwg, Glamorgan.*—1st *November*, 1883.—(*Not proceeded with.*) 2*d*.

The upper part of the lamp consists of the frame for double glasses or glass tubes, gauze tube, metal tube and chimney or lamp top, and the lower part of the lamp consists of the lamp proper with air passages, oil box, wick tube and wick, and appliance for extinguishing the light in the attempt to open the lamp, and the lock to effectually secure the lower to the upper part to prevent the lamp being opened by unauthorised persons.

5189. APPARATUS FOR INDICATING BY FOG SIGNALS THE DIRECTION OF A SHIP'S COURSE, *C. Thomas, South Shields.*—1st *November*, 1883.—(*Not proceeded with.*) 2*d*.

Consists in attaching to the whistle lever an arrangement whereby it is operated during a fog at sea and while the ship is on her course.

5190. MANUFACTURE OF BOBBIN NET OR TWIST LACE, *W. Birks, jun., Nottingham.*—1st *November*, 1883. 4*d*.

Relates to the method of manufacturing a fabric by means of bottom bars and stump bars.

5191. MACHINERY FOR SERRATING THE EDGES OF REAPER KNIVES, SICKLES, &c., *H. Theaker, Sheffield.*—1st *November*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to improvements in the general construction of the machine.

5192. BLENDING VARIOUS KINDS OF SUGAR, TEA, OR OTHER SUBSTANCES, &c., *J. Richards, Tavistock.*—1st *November*, 1883. 6*d*.

Consists of a cylindrical machine provided with a mixing chamber and a netted or meshed discharging chamber and screens or gratings for mixing sugar and other like substances, and balls or weights for crushing lumps thereof, whereby a constant delivery of evenly mixed material may be maintained.

5193. OBTAINING COMPOUNDS OF LEAD FOR MAKING PIGMENTS, &c., *A. French, Morriston, Glamorgan.*—1st *November*, 1883. 4*d*.

Relates, First, to heating a sublimate, consisting principally of sulphite of lead with hydrochloric acid; Secondly, making the sublimate with chloride of lime.

5194. BENDING OR SHAPING ANGLE IRON OR STEEL FOR SHIPBUILDING PURPOSES, &c., *D. G. Reid, Port Glasgow, and D. Thomson, Johnstone.*—1st *November*, 1883. 6*d*.

Relates principally to the arrangement of the rollers.

5195. MANUFACTURE OF POROUS POTS AND POROUS PLATES FOR GALVANIC BATTERIES, *T. Coad, London.*—1st *November*, 1883. 2*d*.

The ordinary clay mixed with a solution of vinegar and sugar is used, and the vessels formed of this are surrounded with plumbago while being baked in a crucible.

5196. CARDING ENGINES, *H. J. Haddan, London.*—1st *November*, 1883.—(*A communication from R. F. Barker, Massachusetts.*—(*Not proceeded with.*) 2*d*.

The inventor combines a rotary brush and a rotary beater with the main card cylinder and the "raising cylinder" thereof, and also uses with these devices an impurity receiving trough.

5198. ELECTRIC TELEPHONE TRANSMITTING AND RECEIVING INSTRUMENTS, *A. F. St. George, London.*—1st *November*, 1883.—(*Not proceeded with.*) 4*d*.

The bell-shaped mouthpiece is replaced by one of cylindrical form, or a tube of carbonised paper may be spoken into. A microphonic contact is also described.

5197. GRAIN PURIFIERS, *H. J. Haddan, London.*—1st *November*, 1883.—(*A communication from L. Bandeville, Arras, France.*)—(*Not proceeded with.*) 2*d*.

Relates to the construction of a machine for winnowing or cleaning grain by means of a blast of air.

5201. TELEPHONE TRANSMITTERS, *G. L. Anders, London.*—1st *November*, 1883. 6*d*.

This relates to microphonic contacts, and consists in surrounding the ends of the electrodes with a sleeve, the contact between the ends of the electrodes being formed through a layer of grains of sodium.

5203. APPARATUS FOR OPERATING AND CONTROLLING RAILWAY POINTS AND SIGNALS, *S. Pitt, Sutton.*—1st *November*, 1883.—(*A communication from R. Bianchi, Turin.*) 8*d*.

Relates to mechanical means by which the inventor can form a central cabin, set the road signals, the bolts of turntables, blocks, &c., by means of an accumulated power, and of liquid transmitting it to absolute conditions which are previously fixed, by a special system of interlocking apparatus, or again to other equally pre-arranged conditions by the same system of interlocking apparatus. Other improvements are claimed.

5205. MANUFACTURE OF ALKALINE EARTHS, &c., *A. C. Henderson, London.*—2nd *November*, 1883.—(*A communication from J. E. Maumené, Lyon.*)—(*Not proceeded with.*) 2*d*.

The inventor employs azotic acid for converting the salts, carbonates, and so forth, into sulphurs, phosphorus, &c., and in calcining the nitrates in retorts lined with clay, without the loss of any product.

5209. SLIP HOOKS, &c., *H. Bezer and P. A. Thomas, London.*—2nd *November*, 1883. 6*d*.

Relates partly to constructing slip hooks or slip links with a weight or equivalent device acting upon the latch, in such manner as to release the latch automatically when not retained in gear by the effect of a weight or body suspended to the pivotted arm or link, the normal position of the latch being out of gear.

5210. ELECTRO-MAGNETIC MACHINES, *N. Rolland and H. B. Ford, London.*—2nd *November*, 1883.—(*Not proceeded with.*) 2*d*.

The armature consists of a series of radial electro-magnets, with their alternate poles placed outwards. This revolves within a concentric ring of compound permanent magnets radially arranged.

5211. FLOORS, THRESHOLDS, &c., *G. W. von Nawrocki, Berlin.*—2nd *November*, 1883.—(*A communication from F. Arnecke and Co., Blankenburg.*) 6*d*.

Relates to the employment of end-grained or cross-grained wood.

5212. MANUFACTURE OF STEEL, *E. W. Crebbin, Liverpool.*—2nd *November*, 1883.—(*Not proceeded with.*) 2*d*.

The molten metal is prepared in the ordinary way, but on its discharge from the converter into the tank or other receptacle, a proportion of manganese, consisting of peroxide of manganese, and also protoxide of manganese, is added.

5213. MANUFACTURE OF CARPETS, *T. Tempest, Radford, Kidderminster.*—2nd *November*, 1883. 2*d*.

Relates to the employment of warp threads consisting of or partly consisting of metallic thread wire or strips.

5214. MOUNTING AND FIXING THE SEATS OR SADDLES OF BICYCLES, &c., *J. Harrington, Coventry.*—2nd *November*, 1883. 6*d*.

Relates to a means of sliding the seat into place and fixing it.

5215. ORNAMENTING CLOTHS, *H. H. Cook and H. Hepworth, Leeds.*—2nd *November*, 1883.—(*Not proceeded with.*) 2*d*.

The object is to produce a fancy speck or spot in several colours on a cloth with a black and white ground.

5216. APPARATUS FOR VENTILATING ROOMS, &c., AND PREVENTING SMOKE, *F. A. Wendt, Croydon.*—2nd *November*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to the construction of a rotating ventilator.

5217. TREATING HIDES OR SKINS IN THE MANUFACTURE OF LEATHER, *W. R. Lake, London.*—2nd *November*, 1883.—(*A communication from Mme. Garnier, Paris.*)—(*Not proceeded with.*) 2*d*.

Relates to apparatus for the successive performance of the various operations attending the mechanical treatment of hides, skips, or skins in the manufacture of leather, from the steeping of the said hides, skips, or skins to the finishing of the same.

5218. BLOWING MACHINES, *F. C. Glaser, Berlin.*—2nd *November*, 1883.—(*A communication from P. B. Glöckner, Halbau, Prussia.*) 4*d*.

Refers to the construction of a blowing machine, in which the hermetic confinement of the air to be forced is effected by a fluid.

5219. PICK AND HANDLE, *J. Crooks, Eckington.*—2nd *November*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to the mode of fixing the pick on the handle.

5220. MANUFACTURE OF RELIEVO MAPS, *H. E. Newton, London.*—2nd *November*, 1883.—(*A communication from J. J. de Mendonca-Cortez, Lisbon.*) 4*d*.

Relates to the method of bringing maps of various kinds into exact and proportioned relief, and consisting mainly in straining and moulding them while in a moistened state upon or between moulds composed of pieces representing proportionately the several height levels of the map.

5221. CURTAINS AND DROP SCENES FOR THEATRES, &c., *F. N. Leyde, Birmingham.*—2nd *November*, 1883. 6*d*.

Consists in constructing the curtains, &c., of wire gauze.

5233. PRODUCTION OF MOTIVE POWER, &c., *W. R. Lake, London.*—3rd *November*, 1883.—(*A communication from C. Emmanuel, Paris.*)—(*Not proceeded with.*) 4*d*.

This relates to the production of continuous motive power by the joint action of gravity and magnetism or electricity.

5251. RECEIVING INSTRUMENT OF SPEAKING TELEPHONES, *H. J. Allison, London.*—6th *November*, 1883.—(*A communication from J. H. Robertson, Brooklyn, N.Y., U.S.*) 6*d*.

The receiver is in the secondary circuit of an induction coil, having in its primary circuit the transmitter. The secondary circuit is so arranged that the induced current passes through microphonic contacts as well as the helix of the receiving electro-magnet.

5252. ELECTRIC LAMPS, *H. J. Haddan, London.*—6th *November*, 1883.—(*A communication from F. H. Werner, Lindenthal, and L. Ochse, Ehrenfeld.*)—(*Not proceeded with.*) 2*d*.

This relates to a lamp adapted to serve either "as an incandescent lamp or as an arc lamp, or as both together."

5254. LUMINOUS CARRIAGE FOR ADVERTISING PURPOSES, *L. L. y Loyola, Paris.*—6th *November*, 1883. 4*d*.

This relates to apparatus for throwing magnified images upon screens forming part of a carriage.

5263. GALVANIC BATTERIES, *C. D. Abel, London.*—6th *November*, 1883.—(*A communication from G. Przibram, H. Scholz, and W. Wenzel, Vienna.*)—(*Not proceeded with.*) 4*d*.

The positive electrode of platinum is placed in a compartment of the cell containing nitric acid, the negative electrode is placed in a solution of common salt, and a third compartment contains concentrated sulphuric acid.

5293. COMMUTATORS OF ELECTRICAL MACHINES, *J. H. Johnson, London.*—8th *November*, 1883.—(*A communication from Z. T. Gramme, Paris.*)—(*Not proceeded with.*) 2*d*.

This relates to methods of adjusting the brushes upon the commutator.

5272. PRODUCTION, REGULATION, AND UTILISATION OF ELECTRIC AND MAGNETIC FORCES, *J. S. Fairfax, London.*—7th *November*, 1883. 10*d*.

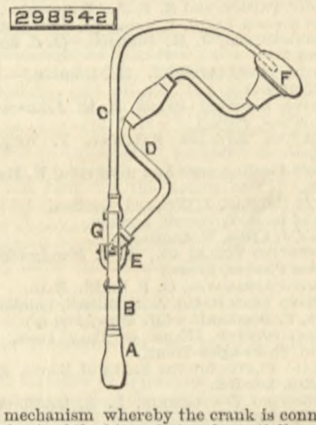
This relates to methods of joining together either single or multiple pieces of short portions of conductors so as to facilitate the operation of placing them in position upon any required form of core and connecting them to a commutator. The conductors are made by stamping, bending, or otherwise shaping suitable sheet metal strips, as described in patent 5060 of 1882. A commutator is described for commutating an alternating current generator so as to transmit a continuous current to the working circuit. The cores of the field magnets are hollow. A regulator is used to either control the speed of an electro-motor, the exciting current or the induced current of a generator, or the speed of the prime motor. There are 46 claims.

SELECTED AMERICAN PATENTS.

Frome United States' Patent Office Official Gazette.

298,542. BIT BRACE, *Charles H. Amidon, Buffalo, N.Y.*—*Filed October* 18*th*, 1883.

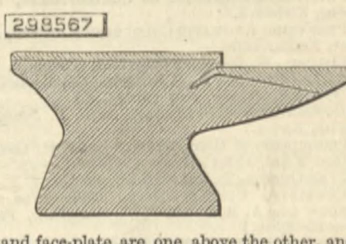
Claim.—(1) The combination, with a bit socket and a crank having its axis arranged at an angle to the bit socket, of mechanism whereby the rotative motion of the crank is transmitted to the bit socket, and an angular or elbow-shaped frame or support, whereby the bit socket and crank are retained in their relative position, substantially as set forth. (2) The combination, with a bit socket and a crank D, having its axis arranged at an angle to the bit socket, of a frame C, having at one end a head F, in which one end of the crank is supported, and at its opposite end a bearing B, in which the shank of the bit socket is supported,



and mechanism whereby the crank is connected with the shank of the bit socket, substantially as set forth. (3) The combination, with the bit socket A and shank *a*, of the crank D, the frame C, having a head F, bearing B, and extension G, and a universal joint E, connecting the crank D with the shank *a*, substantially as set forth.

298,567. ANVIL, *Clark Fisher, Trenton, N.J.*—*Filed December* 20*th*, 1883.

Claim.—An anvil having a steel face-plate and a steel or wrought iron plate covering the horn, the union being effected by casting the iron body on the plates, in which the adjacent extremities of the horn



piece and face-plate are one above the other, and out of contact with each other, and in which the cast metal extends under the entire surface of the face-plate, and between the end thereof nearest to the horn and the horn piece or plate, substantially as and for the purposes set forth.

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