INSTRUMENTS FOR TESTING THE ILLUMINATING POWER OF GAS.

THE difficulty in the way of devising photometers of accuracy, in a scientific sense, is great; nor can the problem be said to be yet solved. The white-hot platinum standard, of which one exists for practical purposes in France, but not in England, is a step in advance, and serves to test what are called standard gas-burners, standard candles, and standard lamps; but the problem has yet to be solved of the accurate comparative testing of lights of different colours. No two empirical white lights from different elements of combustion or incandescence are of the same colour exactly; and when the problem is presented of comparing two lights of widely different colours, there is at present no scientifically accurate method of measurement, although there are several approximations thereto.

Under these circumstances, it may be interesting to place on record some of the best methods at present in practical use for testing the illuminating power of common gas. Messrs. W. Sugg and Co., have such apparatus in daily use at their establishment at Charing-cross, London.

In the first place, when the gas comes in from the main it is passed through a regulator; this consists of a somewhat muffin-shaped iron box, thicker in its centre than at its edges. The gas enters it below a leather disc A, Fig. 1, not so tightly stretched but that it can rise and fall under the varying pressure from the mains; this leather is kept in a wet and supple state for years, by being well soaked in and covered with a solution of gutta-percha in almond oil; some firms use almond oil alone for the purpose. Valves of this nature work well for ten or fifteen years, we are informed, but their life may be shorter when the quality of the gas is inferior. They are necessarily less supple in cold than in hot weather, from the physical properties of heavy oils and gutta-percha, conjointly or separately, under such circumstances. To the centre of the leather a disc of tin A is fixed, carrying a central conical pin. The principle of action of this is represented in Fig. 2, in which A B is the pin depending from the tin disc, and the arrow denotes the direction of the inflowing gas. A sudden pressure of gas thus tends to close the valve, which is opened when there is a falling off in pressure. This regulation is good enough for house pressures and economises gas, but for photometric purposes the gas has subsequently to pass through a more delicate regulator, this first one doing the rough work to give fair play to the sensitiveness of the second controller. The main regulator is set at such a tension as to equal the pressure of a column of water 1in. high.

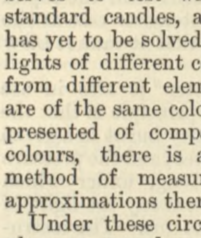


FIG. 1

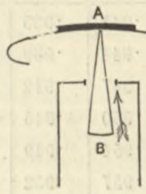


FIG. 2

The gas is next passed through an air-pump-like bell jar, of about one quart capacity, in which it is tested for sulphuretted hydrogen. It enters near the bottom of the jar, from six arms disposed horizontally and star-shaped, as in Fig. 3, and blows against strips of pure paper soaked in pure acetate of lead. The slips hang upon little hooks in the bell jar, with their surfaces not far from the mouths of the jet. With good gas they should not be discoloured in twenty-four hours. When they are discoloured, the proportion of sulphuretted hydrogen in the gas is estimated, if necessary, by chemical methods. These papers, charged with acetate of lead, are bought ready prepared; they are regular articles of sale in connection with the gas industry. The lower part of the bell jar stands in a circular groove filled with mercury, to prevent the escape of gas. The gas is next conducted into the meter, which for photometric purposes must, of course, be of exact and delicate construction, although its more essential parts are on the same principle as the common wet meter, the amount of gas passed being measured by the displacement of an equal volume of water. The face of the photometric meter has one large and two subsidiary dials. Of the two small dials, one indicates the amount of gas passed, the other the time; the latter is a slow motion indicator of time, making one complete revolution in ten minutes. Each complete test of the illuminating power of gas, according to legal requirement, occupies ten minutes, with one observation made every minute, and the average of the ten then taken. The other small dial indicates the amount of gas passed; the index makes one revolution for every cubic foot of gas, and the figures on the circumference of the dial divide the total revolution into twelfths. The large dial has a seconds' hand for time, and the hand makes one complete revolution in a minute. The operator, in making an observation, starts this hand at the exact minute, and stops it when the standard candles, used according to law, have burnt the weight of sperm they ought to consume in ten minutes. The clock is a check upon the accuracy of the Act of Parliament candles. Another hand on this dial indicates the hourly rate of consumption of gas per minute. The meter has a thermometer to give the temperature of the gas, as less combustible material necessarily passes through the meter in hot than in cold weather because of the expansion of gases by heat. The bulb of the thermometer enters the meter, but does not touch the water. Corrections of observations for temperature are applied afterwards by calculation; 60 deg. Fah. is the standard selected by law. This correction is a necessary one, for a temperature of 80 deg. lowers the illuminating power of gas by nearly one candle. The barometer has also to be read within a range, for practical purposes, of from 28in. to 31in., and observations are reduced by calculation to the standard of 30in., required by law. A variation to the extent of the whole range of 3in. makes about one candle difference in illuminating power. The meter is a very accurate one, neverthless it has apparatus attached for driving exactly a cubic foot of air through it when desired to see that it is in perfect working order.

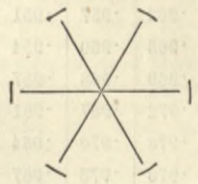


FIG. 3

From the meter the gas flows to the balance governor, a more delicate regulator by far than the one it first encountered. It consists of a balanced beam like that used in chemical scales, at one end of which is suspended a miniature gasometer; this gasometer is made of pure tin, a metal on which common coal-gas has no chemical action. Its valve is of the same nature as that represented in Fig. 2. To the other end of the beam small weights can be quickly added and removed, as on a Syke's hydrometer, whereby any desired pressure of gas for the photometer may be readily obtained. With two governors, the second more sensitive than the first, a steadier flame can be obtained than with one alone. Next the gas passes through micrometer three-way cock. With the taps set one way, the gas passes from the main directly for the use of the house, and not through the photometer at all; with the taps set the other way, it passes through the photometer. It is called the micrometer cock, because a micrometric circle indicates the last position, say at night, of the photometer tap, and if the tap be again put in that position next morning all the various adjustments of the photometer completed the night before require no new setting to begin work in the morning under the conditions in which they were discontinued. Before the gas enters the first governor from the main there is another three-way cock to throw the more delicate parts of the photometer out of the gas circuit if desired, and to turn the gas direct into the house system of pipes. From the balance governor and micrometric tap the gas passes to the point of ignition of the flame to be tested by the more vital portion of the photometer, but the tubular arrangements are such that before reaching this portion of its path it can be at any moment turned into a "King's gauge," whereby its pressure when it enters or leaves the meter, or any other portion of the apparatus already described, can be ascertained. There are means also of testing the gauge quickly to show whether it is accurately set to its true zero. The principle of the gauge is that the gas in it acts against a column of water $1\frac{1}{2}$in. high, and the indications are magnified for the observer by means of multiplying apparatus.

The Sugg's burner, from which the flame is at last produced, is recognised by the Board of Trade. It is on the Argand principle, consumes 5ft. of gas per hour, and the gas then should give a light of 16 candles, if it be up to the standard required for London. The lower part of the burner consists of three fine tubes, surmounted by a brass chamber, capped with a ring of steatite pierced with twenty-four holes. Outside the pierced ring of steatite is a metal cone, through the interior of which air rises, and is thrown against the outside of the flame, in which respect the arrangement differs from the common Argand burner. Air enters also the interior of the flame, as in the ordinary Argand burner. The holes in the steatite are carefully ground to the exact size. The plain cylindrical glass chimney outside the flame is 6in. long by 2in. diameter. This is important, because the taller the chimney, the shorter the flame—a point to which gas consumers should pay attention. When the chimney is too short the flame smokes.

This standard burner is represented in Fig. 4, and is

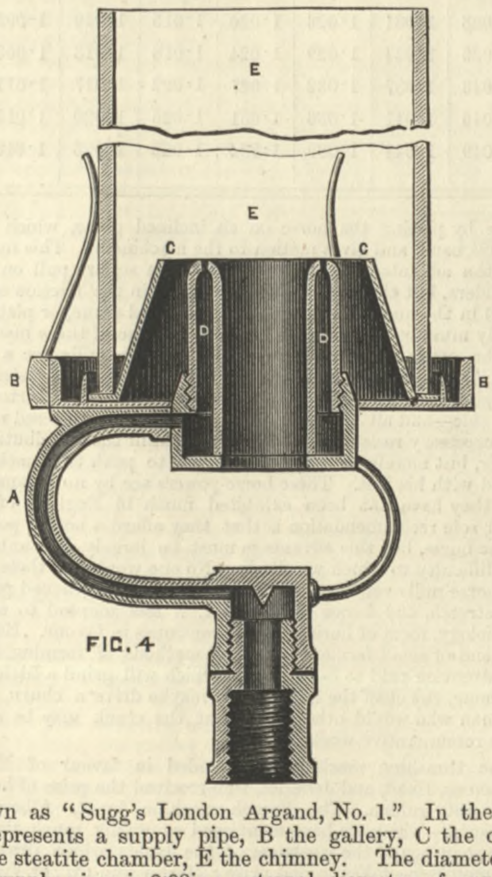


FIG. 4

known as "Sugg's London Argand, No. 1." In the cut A represents a supply pipe, B the gallery, C the cone, D the steatite chamber, E the chimney. The diameter of the supply pipes is 0·08in.; external diameter of annular steatite chamber, 0·84in.; internal diameter, 0·48in.; number of holes, twenty-four; diameter of each hole, 0·045in.; internal diameter of the cone at the bottom, 1·5in.; at the top, 1·08in.; height of upper surface of cone and of steatite chamber above floor of gallery, 0·75in.; height of glass chimney, 6in.; internal diameter of chimney, $1\frac{7}{8}$in. The light from this standard gas-burner has to be tested against that from a pair of the English standard candles, and a vital point in the matter is that the centre of the gas flame and the two centres of the candle flames shall be a fixed distance apart; the selected distance is 60in. This is done by the aid of two fine plumb lines.

Between the two candle flames and the single gas flame is the apparatus for indicating the relative intensities of the lights, and simple as it is, depending also upon physiological impressions and nervous action, it is yet accurate enough to measure within the luminous intensity of about $\frac{1}{100}$ part of a candle flame. It consists of a disc of cartridge paper, plain cartridge paper in the centre, as at A, Fig. 5; the outside ring B of the cartridge paper is rendered more transparent by treatment with a solution of wax. These waxed papers are regular articles of commerce, and bought ready prepared. The edge of the disc is turned to the observer as at A, Fig. 6; behind it are two glass mirrors, by means of which the operator sees the two sides of the paper at once. The mirrors and paper are mounted on a small railway carriage, which can be shifted backwards and forwards on its wheels between the two lights till they balance each other, at which point the unwaxed centre of the disc is not distinguishable from the other portion. The truth of the angle at which the mirrors are set is an essential point, consequently they can be turned bottom upwards so as to be reversed in relation to the two lights, when their action should be the same as before. Cartridge paper is chosen, because with thinner paper there is not sufficient contrast between the waxed and the unwaxed portions. Sometimes the central part of the paper is not circular, but so waxed that it has the form of a star. Mr. Sugg's operator at Charing Cross prefers the circular centre. The star disc is built up of three pieces of paper. The carriage runs over a bar, graduated to at once indicate the relative intensities of the two lights, instead of getting at it by separate calculations in accordance with the law that the intensity of light varies inversely with the square of the distance from its source.

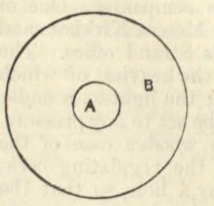


FIG. 5

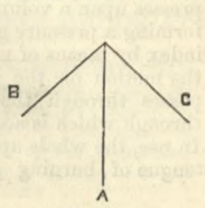
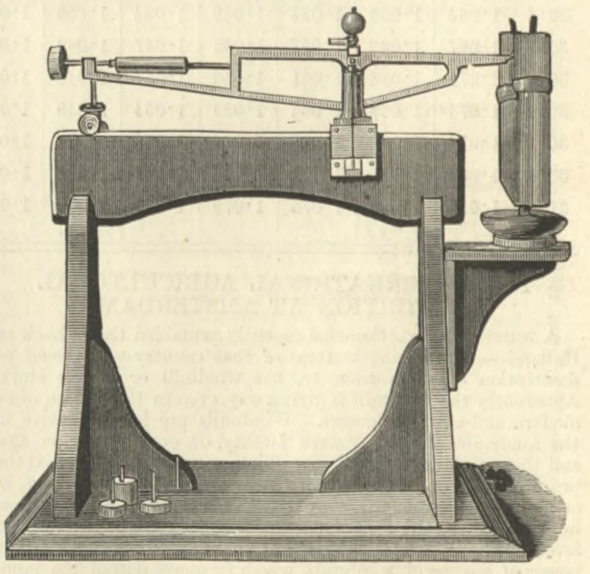


FIG. 6

Standard candles are articles of commerce; those in use at Charing-cross are made by Messrs. Brecknall and Turner; they run six to the pound, and consume 100 grains of combustible matter in an hour. When used they are placed at one end of a balance—Fig. 7—and when the equilibrium is established, which is best done by letting the pair of candles burn to it, a 40-grain weight is placed in the saucer below the candles, and the clock of the meter is started by hand. When the 40 grains are burnt, which should be in ten minutes, the clock is stopped, and thus the exact time is indicated. The completion of the burning of the 40 grains is shown by the turning of the balance. The little tray below the candles catches all drippings of grease. Messrs. Sugg inform us that the standard burner is supposed to be tested by the candles, but that actually it is the other way, the candles being tested by the standard burner. Scientifically, a mean is struck between two sets of small inaccuracies; hence the necessity felt at the Electrical Congress in Paris for an absolute standard.

FIG. 7



Mr. Sugg gives the following instructions for the use and management of this part of the apparatus:—

"About ten minutes previous to the commencement of a photometrical experiment, having first adjusted the candles to the proper height, light them and the gas, and regulate the consumption of the latter to the rate of 5ft. per hour. When the candles have attained their normal rate of burning—which is evidenced by the slightly bent and glowing appearance of the wicks—gently move the sliding counterpoise along the balance beam towards the centre, until the candle end is slightly the heavier. As the sperm is consumed the candle will very gently and gradually rise, so that the index of the balance will be brought to zero of the scale. At this moment the minute-clock must be started, and the experiment has then commenced.

"A 40-grain weight is then to be added to the candle-scale-pan attached to it, and the first reading of the photometer taken at the end of the first minute; and the remainder at intervals of one minute, until the termination of the ninth minute, the tenth can be read after the candles have come again into equilibrium. Now watch the index of the balance, and when it again reaches zero the minute-clock must be instantly stopped.

"Should the time taken to consume the 40 grains of sperm have varied from the correct time of ten minutes, the number of minutes and decimal parts of a minute actually taken must be observed, and by referring to the table a number will be found representing the quantity of sperm that would have been consumed by the two candles in ten minutes, which number being multiplied by the average readings of the photometer and divided by 20 will give the illuminating power of the gas in terms of standard candles consuming at the rate of 120 grains per hour, the only correction necessary being for the temperature of the gas and the barometric pressure of the atmosphere at the time of the experiment should these have varied from the standard of the 60 deg. Fah. and 30in."

The whole arrangement described thus far is a Letheby's improved photometer, of which several have been made by Messrs. Sugg and Co. for the Canadian Government, and others for various English gas companies. One of Lowe's jet photometers, improved by Messrs. Kirkham and Sugg, is also in use at Messrs. Sugg's Strand office. The gas enters by two leather governors, the heaviest of which is set at the pressure of 1in. of water; the lightest is under the control of the operator and can be set to any pressure. These two governors are outside the wooden case of the photometer. The gas next passes to the regulating cock, which is pierced by a slit and not by a hole, so that the pressure may be more gradually regulated. On entering the case, the gas is passed into a chamber, in which it presses upon a volume of water carrying a float, the whole forming a pressure gauge. The float is connected with the index by means of multiplying gear, which gear magnifies the motion on the half-circle of the dial. The gas next passes through the cylindrical steatite burner, the hole through which is accurately ground to its proper diameter. In use, the whole apparatus is so adjusted that the vertical tongue of burning gas shall be exactly 7in. long. The principle of this photometer is, that the richer the gas in illuminating power, the less will be the pressure necessary to produce the 7in. flame, consequently the value of the gas is determined by the pressure upon it necessary to produce the result, which pressure is accurately indicated by the apparatus. The axis of the index works upon friction rollers, which have been found to greatly exalt the sensitiveness of its motions. The water level in this instrument being liable sometimes to vary quickly by evaporation, a screw plunger is under the control of the operator, by pressing down which plunger into the water, the level of the latter can be quickly regulated as desired. The instrument is also furnished with a cock to blow off its gaseous contents quickly, when a fresh sample of gas has to be introduced. The white glass front of the case of the photometer has a sheet of cobalt blue glass, 7in. wide, crossing it, and in regulating the length of the flame, the top and bottom of the latter have to be made to coincide with lines from the eye of the operator, passing the top or bottom of the blue glass, to lines marked on the wooden back of the inside of the case of the photometer. These photometers are much in use in gasworks, the same gas sometimes passing through five or six in all of them at different stages of its manufacture, so that when the quality of the gas alters anywhere, the man on the watch gives warning at once. About a dozen of these photometers are in use in Bromley gas works alone. They work continuously, and are not very liable to get out of order, so are more useful for testing than are the standard candles. They must, however, be kept in good repair. At the top of the photometer case are two concentric chimneys of perforated zinc, to pass off the products of combustion without interfering with the steadiness of the flame. The outer chimney is cylindrical, and closed at the top; the inner chimney has a conical form. The waste products escape horizontally, chiefly through the perforations near the top of the outer cylinder. Air enters the photometer case at the bottom, underneath the apparatus, so that it cannot blow directly upon the flame.

The "Sugg illuminating power meter" is also in use on the premises in the Strand. Its principle is that the richer the gas, the less is the quantity burnt in a given time. A standard Argand burner is used, and the pressure is so adjusted that the flame is 3in. long, under which conditions 16-candle gas should give exactly the light of sixteen candles, with a consumption of 5ft. The instrument is of use in gas works for rapid gas tests, as it takes but about five minutes to adjust.

The "Methven screen" is much used in gas works. It consists of a small rectangular opening in a metal plate, permitting light equal to that of two candles to pass from a standard gas flame 3in. long placed behind it. It will work accurately enough for practical purposes, with the variations between 15 and 20-candle gas.

Table to Facilitate the Correction of the Volume of Gas at Different Temperatures and under Different Atmospheric Pressures.

Bar.	Ther. 40°	42°	44°	46°	48°	50°	52°	54°	56°	58°	60°	62°	64°	66°	68°	70°	72°	74°	76°	78°	80°	82°	84°
28·0	·979	·974	·970	·965	·960	·956	·951	·946	·942	·937	·932	·927	·922	·917	·912	·907	·902	·897	·892	·887	·881	·875	·870
28·1	·983	·978	·973	·969	·964	·959	·955	·951	·945	·941	·936	·930	·926	·921	·916	·911	·905	·900	·895	·890	·884	·879	·873
28·2	·986	·981	·977	·972	·967	·963	·958	·953	·949	·944	·939	·934	·929	·924	·919	·914	·909	·904	·898	·893	·887	·882	·876
28·3	·990	·985	·980	·976	·971	·966	·961	·957	·952	·947	·942	·937	·932	·928	·922	·917	·912	·907	·902	·896	·891	·885	·880
28·4	·993	·988	·984	·979	·974	·970	·965	·960	·955	·951	·946	·941	·936	·931	·926	·921	·915	·910	·905	·900	·894	·888	·883
28·5	·997	·992	·987	·983	·978	·973	·968	·964	·959	·954	·949	·944	·939	·934	·929	·924	·919	·914	·908	·903	·897	·892	·886
28·6	1·001	·995	·991	·986	·981	·977	·972	·967	·962	·958	·953	·947	·943	·938	·932	·927	·922	·917	·912	·906	·901	·895	·889
28·7	1·004	·999	·994	·990	·985	·980	·975	·970	·966	·961	·956	·951	·946	·941	·936	·931	·925	·920	·915	·909	·904	·898	·893
28·8	1·007	1·003	·998	·993	·988	·984	·979	·974	·969	·964	·959	·954	·949	·944	·939	·934	·929	·924	·918	·913	·907	·901	·896
28·9	1·011	1·006	1·001	·997	·992	·987	·982	·977	·973	·968	·963	·958	·953	·948	·942	·937	·932	·927	·921	·916	·910	·905	·899
29·0	1·014	1·010	1·005	1·000	·995	·990	·986	·981	·976	·971	·966	·961	·956	·951	·946	·941	·935	·930	·925	·919	·914	·908	·903
29·1	1·018	1·013	1·008	1·004	·999	·994	·989	·984	·979	·975	·969	·964	·959	·954	·949	·944	·939	·933	·928	·923	·917	·911	·906
29·2	1·021	1·017	1·012	1·007	1·002	·997	·992	·988	·982	·978	·973	·968	·963	·958	·952	·947	·942	·937	·931	·926	·920	·914	·909
29·3	1·025	1·020	1·015	1·011	1·006	1·001	·996	·991	·986	·981	·976	·971	·966	·961	·956	·950	·945	·940	·935	·929	·923	·918	·912
29·4	1·028	1·024	1·019	1·014	1·009	1·004	·999	·995	·990	·985	·980	·975	·969	·964	·959	·954	·949	·943	·938	·932	·927	·921	·915
29·5	1·032	1·027	1·022	1·018	1·013	1·008	1·003	·998	·993	·988	·983	·978	·973	·968	·962	·957	·952	·947	·941	·936	930	·924	·919
29·6	1·036	1·031	1·026	1·021	1·016	1·011	1·006	1·001	·996	·992	·986	·981	·976	·971	·966	·960	·955	·950	·944	·939	·933	·927	·922
29·7	1·039	1·034	1·029	1·025	1·019	1·015	1·010	1·005	1·000	·995	·990	·985	·980	·974	·969	·964	·959	·953	·948	·942	·937	·931	·925
29·8	1·043	1·038	1·033	1·028	1·023	1·018	1·013	1·008	1·003	·998	·993	·988	·983	·978	·972	·967	·962	·957	·951	·946	·940	·934	·928
29·9	1·046	1·041	1·036	1·031	1·026	1·022	1·017	1·012	1·007	1·002	·997	·991	·986	·981	·976	·970	·965	·960	·954	·949	·943	·937	·932
30·0	1·050	1·045	1·040	1·035	1·030	1·025	1·020	1·015	1·010	1·005	1·000	·995	·990	·985	·979	974	·968	·963	·958	·952	·946	·941	·935
30·1	1·053	1·048	1·043	1·038	1·033	1·029	1·024	1·019	1·014	1·009	1·003	·998	·993	·988	·983	·977	·972	·966	·961	·955	·950	·944	·938
30·2	1·057	1·052	1·047	1·042	1·037	1·032	1·027	1·022	1·017	1·012	1·007	1·002	·996	·991	·986	·980	·975	·970	·964	·959	·953	·947	·941
30·3	1·060	1·055	1·050	1·045	1·040	1·036	1·030	1·025	1·020	1·015	1·010	1·005	1·000	·995	·989	·984	·978	·973	·968	·962	·956	·950	·945
30·4	1·064	1·059	1·054	1·049	1·044	1·039	1·034	1·029	1·024	1·019	1·014	1·008	1·003	·998	·993	·987	·982	·976	·971	·965	·959	·954	·948
30·5	1·067	1·062	1·057	1·052	1·047	1·042	1·037	1·032	1·027	1·022	1·017	1·012	1·006	1·001	·996	·990	·985	·980	·974	·969	·963	·957	·951
30·6	1·071	1·066	1·061	1·056	1·051	1·046	1·041	1·036	1·031	1·026	1·020	1·015	1·010	1·005	·999	·994	·988	·983	·977	·972	·966	·960	·954
30·7	1·074	1·069	1·064	1·059	1·054	1·049	1·044	1·039	1·034	1·029	1·024	1·018	1·013	1·008	1·003	·997	·992	·986	·981	·975	·969	·963	·957
30·8	1·078	1·073	1·068	1·063	1·058	1·053	1·048	1·043	1·037	1·032	1·027	1·022	1·017	1·011	1·006	1·000	·995	·990	·984	·978	·972	·967	·961
30·9	1·081	1·076	1·071	1·066	1·061	1·056	1·051	1·046	1·041	1·036	1·031	1·025	1·020	1·015	1·009	1·004	·998	·993	·987	·982	·976	·970	·964
31·0	1·085	1·080	1·075	1·070	1·065	1·060	1·055	1·049	1·044	1·039	1·034	1·029	1·023	1·018	1·013	1·007	1·002	·996	·991	·985	·979	·973	·967

THE INTERNATIONAL AGRICULTURAL EXHIBITION AT AMSTERDAM.

A WRITER in the *Athenæum* recently grumbled that a book on Holland—or professing to treat of that country—contained no description of, or allusion to, the windmill or to the stork. Apparently the windmill is giving way, even in Holland, to more modern and efficient motors. Windmills are less obtrusive in the landscape than they were twenty, or even ten, years ago, and those that are left show by chimney or engine-shed that the proprietors have called steam to their aid. Here and there, as one passes through the country, may be seen a huge engine-house, breaking the line of the horizon on the vast expanse of level meadow. Under the roofs of these large buildings is the power of a score of windmills, which formerly dotted the landscape of those wide pastures, and kept them free of the water, with which man is ever struggling in Holland. But in Holland, as elsewhere, old ideas die hard, and farmers and small traders exhibit the same fear of steam which is to be found in the same classes elsewhere. This feeling has kept the windmill and the horse mill going on many a Dutch farm. The stride from these primitive appliances to the steam engine is too great to be covered at once, and by one generation, and hence we find in a show like that at Amsterdam much attention given to horse powers. The oldest and simplest form of these is that in which the horse is harnessed to a beam, and made to walk round with it. This constant walking in a small circle is not good exercise for horses, and when kept too long at it blindness ensues. But for short spells of work, chaff-cutting, grinding corn, or pumping water, the horse-power is still very handy on those small, or comparatively small, occupations of land where steam is not introduced. Even at the Royal Agricultural Society's Show at Shrewsbury this year, the machinery of the working dairy received its power from a horse which trod its weary round at the back of the shedding. One of the best forms of application of animal power is the treadmill, because the weight of the man or beast is all put into the work; and perhaps the most efficient animal-power machine is that at Carisbrook Castle, where the donkey raises water 200ft. by treading inside a wheel like a squirrel cage. This form of wheel has not been imitated for horses, but an attempt to improve on the old horizontal bar is made by placing the horse on an inclined plane, which is an endless band, and gives motion to the machinery. This method has the advantage of giving the horse a square pull on both shoulders, but the loss of power involved in the friction engendered in the method of keeping the inclined plane, or platform, steady must be immense. There was but one of these machines on the ground, under the head of "Treadle mills for a large farm," and exhibited by Landré and Glinderman, of Amsterdam. The platform was supported on twenty-six castors—thirteen on each side—and all the friction of these was enountered not in the necessary resistance of bearings used in the distribution of power, but merely to enable the horse to push the machinery round with his feet. These horse-powers are by no means new, but they have not been exhibited much in England of late. Their sole recommendation is that they afford a better position to the horse, but this advantage must be largely discounted by the difficulty to which we allude. No one would in these days use horse mills very extensively or for very lengthened periods at a stretch, and hence the simpler, if less adapted to equine physiology, form of horizontal bar continues in favour. Holland is a land of small farmers and small methods of farming, hence the attention paid to horse-power, which will grind a little corn one hour, cut chaff the next, and it maybe drive a churn, while the man who would otherwise be at the crank may be set to more remunerative work.

The thrashing machine trials ended in favour of Messrs. Ransomes, Head, and Jefferies, who received the prize of honour value 500 gulden. The French machine, by A. Albaret, of Liancourt—which we have mentioned as giving much trouble, in consequence of the weakness of the bands which drove the dynamometer—takes second prize; Merlin and Co., of Vierzon, the third; and Messrs. Nalder and Nalder, of Wantage, Berkshire, the fourth. The latter machines stood on the shaky ground, where the corn mill we have mentioned was so severely tried in more than one sense. The machine, called "Simplex," is very compact in its arrangements, and did its work very well. Judging on the Continent is a curious art, and possibly the idea was that not much complaint could be made if an English firm headed the list and one brought up the rear, with two Frenchmen sandwiched between them for second and third prizes, especially as the managers of a Dutch show did not give a prize to their own countrymen. At all events the trials served to initiate the Dutch farmers in the art of threshing by power, and to amuse a large number of spectators who collected round the machines during the three days that the trials lasted. Some of the corn to be threshed in these trials had been cut before ripening, and the rye was very small. Messrs. Ransomes, Head, and Jefferies also received prizes for rakes and haymakers, and four gold and two silver medals for ploughs; the latter implement was not largely shown, but all the leading English makers were represented. In fact, though an agricultural country, Holland has so large an area under pasture that it is not the best possible market for ploughs.

Dairy produce and dairy appliances were, of course, largely shown. A working dairy—not very active, by-the-bye—was established in the grounds. Cheese and butter were exhibited in a great hall, built in the Moorish style, and entered under a handsomely proportioned horseshoe arch. The front of the building exhibits the turrets and colonnades characteristic of the style, and the interior decoration was of the same character. It was in the central avenue of this hall, in a sort of alcove formed by columns in Mauresque style, that the King of Holland met the committee at the inauguration of the Exhibition. His Majesty was in a good position to see the foundation of the wealth of his country, for he had around him the dairy produce, the flax, grain, oil, tobacco, and the manufactured goods, for which the Dutch are famous. The butter and cheese were exhibited with much skill, and the former was cooled by running a stream of water in a wooden flume just over the tubs. One feature of the butter exhibition was highly to be commended. A practised eye may tell the quality of butter in bulk, but less experienced people require some further contact. This was afforded at one or two of the stands by breaking bulk and stationing a young woman to serve out tasting brods. She seemed to do a large trade. The cheese was exhibited in the two forms with which the grocers make us familiar—spherical and flat; but they were varnished and polished to such an extent that almost led one to doubt their identity had not the olfactory nerves been abundantly warned of the presence of kaseine. On the walls and tables of this building were many maps, diagrams, and tables of calculations connected with what we may call the science of agriculture. Models of silos were to be seen here, and amongst the entries, one by Lord Walsingham, which was not to be found on the tables, was entered in the catalogue.

Novelties in the machinery department were almost confined to methods of painting and decorating engine work by some of the Continental exhibitors. Some of these were very gaudy in paint and external metal work. A portable engine encased in polished brass might be distinguished from any part of the ground by those accustomed to the more sober greens and blacks with which we cover our work on this side of the Channel.

LORD RAYLEIGH'S EXPERIMENTS ON LIGHT.

LORD RAYLEIGH, the president of the British Association at Montreal, has in the past devoted much attention to the subject of light; his papers on the subject have appeared in the publications of various scientific bodies, and in the *Philosophical Magazine* and other scientific journals.

In some of his earlier experiments he worked at the reproduction of diffraction gratings by means of photography, the latter having such minute delineating power. At first he thought of drawing gratings on a large scale and then reducing them by means of photography, but abandoned the idea chiefly because he thought it doubtful whether photographic or other lenses were capable of doing the work. He, therefore, began by taking a Nobert's grating with 3000 lines to the inch, and printing an impression from it direct, upon a dry photographic plate, just as transparencies are taken for the magic-lantern. In the printing he used almost parallel rays of solar light, so that if the two plates did not touch at particular places, a shadow image of the adjacent lines might nevertheless be thrown upon the sensitive surface. He thus produced copies comparing not unfavourably with the original. The photographic plates had to be very flat; even patent plate was scarcely flat enough, the use of worked glass being the remedy.

The vehicle for the sensitive photographic salts employed by him was sometimes collodion, sometimes albumen, both of which give delicately thin films. With these vehicles almost any photographic dry process would answer the purpose, and after a little practice he could produce copies equal to the originals in defining power, so far as he could see. After partial development he cleared the more transparent parts with iodine, after which the deposit in the intensifying process fell entirely upon the parts intended to be opaque. With the copies the nickel line between the D lines is easily seen. He worked in a dark room, with a slit in its shutter, and the grating placed at a distance from the slit. No collimator was used. The telescope consisted of a single lens of about 30in. focus, with an ordinary eyepiece held independently. He prefers this arrangement to placing the whole arrangement upon one stand, as in the ordinary spectroscope.

He also experimented on the reproduction of gratings by means of bichromated gelatine, omitting the colouring matters usually added thereto in the carbon process. He poured on the bichromated gelatine as he would collodion, and allowed the film to dry in the dark. The printing was done by a few minutes' exposure to direct sunlight, and the development by treatment with warm water, which dissolved off the gelatine where not acted upon by light. The gratings thus produced were transparent in every part alike, yet they gave brilliant spectra; the effect, therefore, must have been produced by the alternate linear elevations and depressions of the surface. By pressing soft sealing wax on these transparent gratings, the wax assumed the appearance of mother-of-pearl. He does not think that in the development any of the gelatine was dissolved away, but this conclusion, when viewed by the experience of those versed in the carbon process, is doubtful. The gelatine may have been rendered insoluble throughout its front surface, yet some of its organic constituents may have found their way through the exterior skin. There was uncertainty in the production of these gelatine gratings, but one or two of much perfection were made, giving spectra surpassing the original in brightness. The reason, he says, is that "on account of the broadening of the shadow of the scratch, a more favourable ratio is established between the breadths of the alternate parts." From the appearance of these earlier photographed gratings under the microscope, he concluded that 6000 lines to the inch could be printed by the method, by which, also, the cost of diffraction gratings was likely to be considerably reduced.

In later experiments he discovered that he could photograph a piece of striped stuff, to produce an image on such a scale that there was room for about 200 lines in front of the pupil of the eye, capable of showing lateral images of a candle. The reduction was effected in a camera. He soon found that optical appliances are inadequate to the production of very fine gratings, from inherent imperfections in lenses, as well as from impediments due to the laws of light. Nevertheless, he thinks that by means of very special appliances, it might, perhaps, be possible to get 3000 lines to the inch by this method, although the prospect is not particularly promising.

Direct printing from cut gratings he, therefore, considers to be the best method. He takes care that during the printing the glass front of the printing frame is at approximately a right angle to the incident light of the sun. Usually, he cuts off most of the side light by partially closing the shutters of the room, but he cannot say whether this is necessary. With the more sensitive processes artificial light may be employed. Lord Rayleigh made some copies of gratings by the aid of a moderator lamp with its globe removed; the printing was done at a distance of 2ft. All the glass surfaces have to be very clean, the pressure in the printing frame is moderate and even, and when the photographic film is delicate, care must be taken not to scratch it by a sliding rubbing motion. He is careful not to injure the engraved face of a grating, so scarcely ever touches it with wash leather or any other solid. He prefers to wash it, when soiled, with a stream of water from a tap, afterwards flooding it with pure alcohol, and then setting it up to dry spontaneously. After taking several hundreds of copies of his gratings, the originals have scarcely, if at all, deteriorated. He finds that out of a package of two dozen 5 by 4 sheets of patent plate, as sold by the dealers, three or four may usually be selected flat enough for the photographing of gratings. Plates of the size mentioned may be cut with a diamond, and will do very well for four gratings, but it saves work and trouble not to cut them until they have been coated with the photographic film.

Lord Rayleigh, after trying many processes, some of which he abandoned, he says, for reasons which might not have necessitated their abandonment in the hands of a skilled photographer, felt most inclined to recommend Mr. G. Wharton Simpson's collodio-chloride process for preparing the plates. The details of this process may be found in photographic works, but it consists essentially in first coating the plate with dilute albumen, and drying it, then coating it in the developing room with an emulsion of chloride of silver in collodion; the emulsion contains a slight excess of free nitrate of silver. The exposure for printing is about five or seven minutes to the autumn sun; no development is necessary. The plates are washed in water, and then, without any toning, fixed with thiosulphate of soda. He increases the brilliancy of the spectra by finally washing these photographed gratings with corrosive sublimate, which, however, probably destroys their permanency. The use of very finely divided diffraction gratings is, Lord Rayleigh points out, not necessarily an advantage in the investigation of the solar spectrum, although it conduces to brilliancy. He has two by Nobert, one containing 3000 and the other 6000 lines to the square inch. The spectra of the 3000-line grating were much the best in respect of definition, and the same was the case with the photographic copies. The extra brilliancy of spectra with more lines is of no use if a higher magnifying power is necessary than the spectra will bear.

In testing gratings, Lord Rayleigh prefers to work in a dark room, with a slit in the shutter, through which a direct beam of sunlight is steadily sent by means of a heliostat. He makes the slits cheaply, instead of using the ordinary appliances, but, at the same time time, loses the power of regulating the width by a screw motion. His plan is to coat a sheet of glass with tinfoil; weak shellac varnish is used to make the tinfoil adhere; the alcohol is allowed to evaporate, and after application of the tinfoil, the shellac film is softened by heat. Had paste been used, time would have been necessary to permit the drying of the aqueous film between the impermeable glass and tinfoil. To make a slit, it is next only necessary to cut a straight line in the foil with a sharp knife, and to wipe the line of the cut with a rag moistened with alcohol. Broader slits are made by removing the foil between two parallel cuts.

Despite his care in selecting samples of patent plate, it is evident from his records that, altogether, there is much more safety in using samples of worked glass for delicate photographic productions of this kind. With worked glass copies from the 3000-line grating, he can usually make out nearly, but not quite, all that is shown in Angström's map. Among the photographic gratings on picked patent plate there are usually some whose performance is less satisfactory, though most of them, under low powers, will bear fair tests. He is uncertain as to the limits attainable of photographing fine lines in this way, but thinks it possible, that with a flexible support to the film, such as mica instead of glass, ten or twelve thousand lines to the inch might be copied. Gratings may also be made on Brewster's principle, by taking a cast. Lord Rayleigh has obtained fair results by allowing filtered gelatine to dry, after being poured on the 3000-line Nobert grating. This method is attended with risk to the original, and has other objections.

In the present article we have summarised one portion only of Lord Rayleigh's researches on light, and may deal with the rest hereafter.

FOREIGN NOTES.

THE competitive torpedo boat trials, instituted for the purpose of determining the most suitable design of this class of craft for the Imperial German Navy, have now commenced at Kiel. On the 25th ult., General von Caprivi, the Minister of Marine, opened the trials in person, and some months must necessarily elapse before they are brought to a close. As yet but three firms have sent their experimental torpedo boats to Kiel, viz., Messrs. Schichau, of Elbing, Messrs. Thornycroft, of London, and the Vulcan Company, of Stettin. Two further firms—the Weser Company, of Bremen, and Messrs. Yarrow and Co., of London—will place their boats at the disposal of the Imperial Admiralty within a few weeks' time. When it became known that foreign builders had been invited to supply boats for trial, the press of the Fatherland took the matter up, and it is therefore impossible for the general public to form a true estimate of what is really taking place. In England such a proceeding would be impossible, as every technical question is judged upon its own merits, from whatever part of the globe it may have emanated. At present there are three *bonâ fide* torpedo boat builders in Germany, viz., at Bremen, Stettin, and Elbing, all of which have simply followed the lead of Messrs. Yarrow and Thornycroft, utilising the experience of those firms, which they publish so freely.

Now, as well-known German builders, such as the Vulcan and Weser Companies, do not systematically supply the general German press with anecdotical accounts of extraordinary trial trips, it is natural that an overflow must be found somewhere. The boats supplied by Mr. F. Schichau, of Elbing, the builder of such celebrated vessels as the Mowe, Habicht, the Rhine tug Disch, and the Schichau torpedo boats for Russia, therefore afford the best subject for eulogy. Here is an extract from one of the first German military papers:—"The English Thornycroft boat had realised a speed of 19·9 knots on the Themse with a German crew. . . . . The Weser boats were unsuccessful, and the Vulcan boats did not approach the results attained by the English boat—Thornycroft. A great change took place, however, when the Schichau boat took part in the trials, and this wonderful craft realised the speed of 21·26 nautical miles per hour, beating the Thornycroft boat by one mile per hour." Within the last few months article upon article has appeared in the German press on the same subject, and the only question is, "Why does not the whole world acknowledge the supremacy of the 'Fatherland Shipbuilding Industry'?"

The answer is simply this, viz., that it is a very easy matter to build a steel shell, 37 metres long, to hold engines of 1000 indicated horse-power, but that the simple fact of driving a shaky boat through the water at 21 knots per hour is worthless for anything but advertisement. It has already been observed that two English firms—Thornycroft and Yarrow—have received orders to supply boats for trial. The first-named firm has sent two boats to Kiel, a second-class and a medium first-class boat. Now it is known that these English boats have not met with a single mishap, whilst the Vulcan Company has had trouble with its engines, the Weser Company with its boilers, and the Elbing firm with the entire hulls of their boats, as, for instance, twisting the rudder and rudder frame almost double. The admirable work turned out by the Vulcan Company for the Chinese Government proves very clearly what can be done by a substantial firm when left to its own resources, and though the small boats supplied by this firm cannot possibly equal in speed the large Elbing boats, it is generally known that they surpass the latter in strength and durability. A second-class boat, built by Messrs. Thornycroft, has not been approved by the German Admiralty owing to its small breadth of beam and consequent unseaworthiness, but it is reported that another English firm has sent in a design for a combined steam launch and torpedo boat, having a mean speed of at least 14·5 knots per hour, which is likely to fulfil all requirements that can be made on this class of craft. It will be remembered that Messrs. Yarrow and Co., of Poplar, have undertaken to supply a torpedo boat of the first-class to the German Government. It is expected that this craft will arrive in Kiel Harbour during the last week of the present month, and that the regular tug of war will then begin, as the first batch of Weser boats will probably have been provided with new boilers by them.

It is reported that Mr. Friedrich Krupp, of Essen, will before long hold a series of important gun trials on his range near Duelmen, so that the qualities of the latest design of Krupp gun may be tested in the presence of the leading artillerists of Europe. These trials are expected to prove even more interesting than those which took place on the same ground some years back, as very little trustworthy information has been published of late regarding the doings at Essen.

The trials of the Imperial Chinese "protected" cruiser Tsi Yuen have just come to a very successful termination, both as regards speed and power of manœuvring. The speed guaranteed by contract was 15 knots per hour, but this rate was exceeded by nearly one knot per hour during a four hours' run. Mr. Haack, of the Vulcan Company, Stettin, deserves much credit for introducing a new and successful type of deck-armoured cruiser, as the design of the Tsi Yuen presents many novelties.

LOUGH ERNE DRAINAGE—LARGE SLUICE AT BELLEEK.

ON page 218 we give the first of several engravings representing the large new sluices erected at Belleek, from the designs and under the free roller system patents of Mr. F. G. M. Stoney, M.I.C.E., of Westminster. Further drawings with description of these remarkable sluices will appear in another impression.

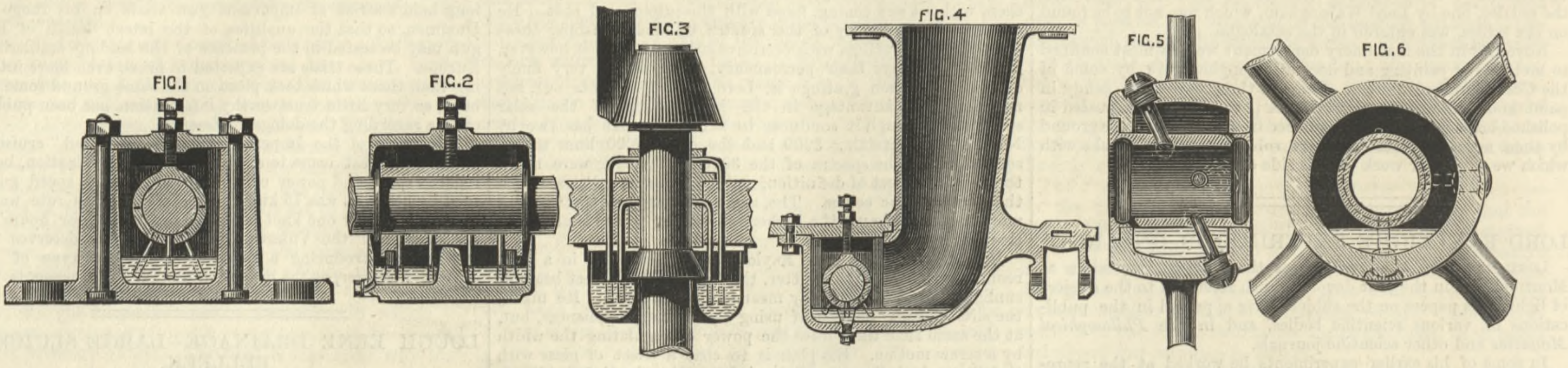
A BRIEF HISTORY OF ELECTRIC AND MAGNETIC LOCOMOTION.

By E. M. BENTLEY.

THE electric motor was invented over fifty years ago, and has been in extensive use ever since. The first inventor is a matter of some dispute, but the invention follows very naturally from the investigations in electro-magnetism made by Professor Henry about 1830. Probably the first motor giving direct rotary motion was made by Sturgeon in 1832. A number of others soon followed, but the one attracting the most attention, and on which great hopes were based, was invented by Thomas Davenport, of Brandon, Vt., and was fully described in the *American Journal of Science and Arts* for April, 1837. Of his experiment it was said, "One of the machines with a motive wheel only 7in. in diameter has been attached to a turning lathe, and moves it with astonishing strength compared with the small size of the propelling engine." We also find the following financial appeal, which to the stock sellers of the present day must seem an example of untutored simplicity: "For the purpose of raising funds to carry on experiments, &c., a joint stock association has been formed in New York, of which Mr. Edwin Williams, No. 76, Cedar-street, is agent. By this arrangement, the principal interests of the patent for the United States and Europe being placed in a stock of three thousand shares, the proprietors offer an opportunity to public spirited individuals to become associated with them in the enterprise, which it is hoped for the benefit of mankind may be successful." Another electric motor attracting wide attention about that time was invented by Professor Charles G. Page, of Washington, D. C. An account of this motor and its application to locomotive purposes was given in a lecture delivered by the inventor in New York, and printed in the *Scientific American* of November 15th, 1851. At that early date electric motors were successfully applied to locomotion, both on land and water. In April, 1837, Sturgeon announced his having succeeded in propelling a boat, and also a locomotive carriage, by electro-magnetism—see "Sturgeon's Annals of Electricity," vol. i. p. 250. In the same publication for October, 1840, are given a cut and description of the electric locomotive of Uriah Clark, of Leicester, England, which was run for two months on a circular track at the Leicester Exhibition of that year. Davenport, whose motor was mentioned above, ran a locomotive in 1842 on a railway near Glasgow. This locomotive, which is described in the lecture by Professor Page, above cited, weighed five tons, and developed 1-horse power, attaining a speed of four miles an hour. In this country, about the same time, Professor Page obtained an appropriation from Congress to aid in experiments on this subject, and constructed a locomotive which travelled from Washington to Bladensburg on the Baltimore and Ohio Railroad. In electric locomotion by water, the most successful inventor was Professor Jacobi, who, in 1839, propelled a boat by electricity on the Neva. The following very interesting letter from Jacobi to Faraday is found in the *Mechanics' Journal*, 1839, vol. xxxii. p. 64:—"During the past autumn, and at a season already too far advanced, I made, as you perhaps have learned from the gazettes, the first experiments in navigation on the Neva, with a ten-oared shallop furnished with paddle-wheels, which were put into motion by an electro-magnetic engine. Although we journeyed during entire days, and usually with ten or twelve persons on board, I was not well satisfied with this first trial; for there were so many faults of construction and want of insulation in machines and batteries which could not be repaired on the spot, that I was terribly annoyed. All these repairs and important changes being accomplished, the experiments will shortly be recommenced. If Heaven preserve my health, which is a little affected by continual labours, I hope that within a year from this time I shall have equipped an electro-magnetic vessel of from 40 to 50-horse power." In all the inventions I have described the source of electricity was a galvanic battery carried by the locomotive itself; but others used a stationary generator, and conducted the electricity to the propelling motor by means of conductors laid along the track or by the rails themselves. Mr. Pinkus, an Englishman, invented, in 1840, an electric railway of this description; from his stationary source of supply the current was led to his moving locomotive by two copper conductors, which were fastened to a beam of insulating material laid between the rails; two sliding blocks of copper depended from the locomotive and rested in contact with the two conductors respectively, and from thence to the two blocks the current passed to the propelling motor on the train. Mr. Pinkus' electric railway is fully described in his English patent, No. 8644, of 1840. A railway of this kind is described in the *Mechanics' Magazine* for 1847, vol. xlvii., page 559. It was invented by Messrs. Lilly and Colton, of Pittsburg, Pa. In the description it is said: "The power is applied, not to the locomotive, but to the track, and herein consists the novelty of the invention or discovery. Two currents of electricity, positive and negative, are applied to the rails, and from thence communicated with the engine. The latter is provided with two magnets, which, by a process of attraction and repulsion, drive the car over the track. Heretofore the propelling power has been used on the car itself; in this instance, however, the power is in the rails, and an engineer may remain in one town and with his battery send a locomotive and train to any distance required." Of a later date is the railway of Bellet and De Rouvre, described in an English patent of 1864, No. 2681, in which two wires are stretched beneath the car to convey the current to the locomotive; also that of Hallez de Arros, of Nancy, France, in 1873, in which the inventor in his patent says, after describing his locomotive: "The battery or source of electrical power may be mounted on the carriage, as above described, or it might be fixed in position and the electrical current might be transmitted by conductors laid along the rails, or by the rails themselves."

In the railway invented by Mr. W. H. Knight and myself, which has recently gone into practical operation in Cleveland, in connection with the Brush system, we make no extravagant claims to be the first persons to whom the idea of electric locomotion has come, but we do claim that we have taken up only devices which are free as air to every inventor, and by inventions of the utmost importance have rendered electric railways a practical success. — *Scientific American.*

CANE LUBRICATORS.



THE following description of a new and very simple form of lubrication now being largely used in France, but, we believe, unknown in England, will interest all those of our readers to whom the question is of importance:—This system introduces an entirely new principle of lubrication, and one of undoubted efficacy. The extreme simplicity of the mechanism, in ordinary cases being exposed to full view, is one of the best guarantees of its working with regularity. In all cases the apparatus consists of (1) a reservoir for oil at bottom; (2) a gun-metal cushion or bearing in two parts, firmly fixed in grooves in the oil vessel and provided with ribs, which form it, as a whole, into a rectangular casing; (3) a tightly fitting cover, or upper bars, which not only completes this cage, rendering the whole arrangement firm, but also isolates the oil vessel and the bearings from all contact with foreign substances. The cover is centrally pierced by a regulating screw with a nut, which regulates the play of the bearings. A pipe at the side of the reservoir shows the level of the oil within, and affords a means of re-filling the vessel when necessary. The mechanism for lubrication consists of a certain number of small capillary tubes in groups, fixed in the bearing, which they pierce perpendicularly to the axis of the shaft, and having their lower extremities plunged in the oil chamber. These capillary tubes are made of stalks of Indian rattan cane, forcibly driven into holes pierced in the bearing to receive them, and then cut off flush with the surface of the bearing; they are consequently in constant contact with the shaft or spindle. It will be readily understood that the rotation of the spindle draws the molecules of oil through the tubes of the cane touching it. This empties the tube, and creating a vacuum, draws up, and at the same time filters, the oil from the vessel; and this double action is performed more vigorously the more rapidly the spindle revolves. A coating of oil thus continuously enveloping the spindle and the bearings, the friction is reduced to a minimum. Perfect lubrication is thus ensured, with economy in oil, and in hand labour—a very sensible diminution in the motive power required, and absolute safety from the heating of the bearings, which is so much to be dreaded in all engines. One single objection has been urged against the system, which otherwise every one has found perfectly to answer all requirements, namely, "the tubes will in time become choked." On the contrary, all experience hitherto—some of the lubricators having been in use for several years, often under abnormal conditions and under all temperatures, as in the winter of 1879-80—has gone to prove that these tubes, far from being choked by use, acquire, on the contrary, greater capillary power. These lubricators can replace all ordinary or other lubricators, both for plain shafts and for those with collars. The fact of the system of supply only allowing the bearing to be oiled up to the collar of the shaft, prevents all leakage and keeps everything very clean. They can be left alone without attention or further supply of oil for a year.

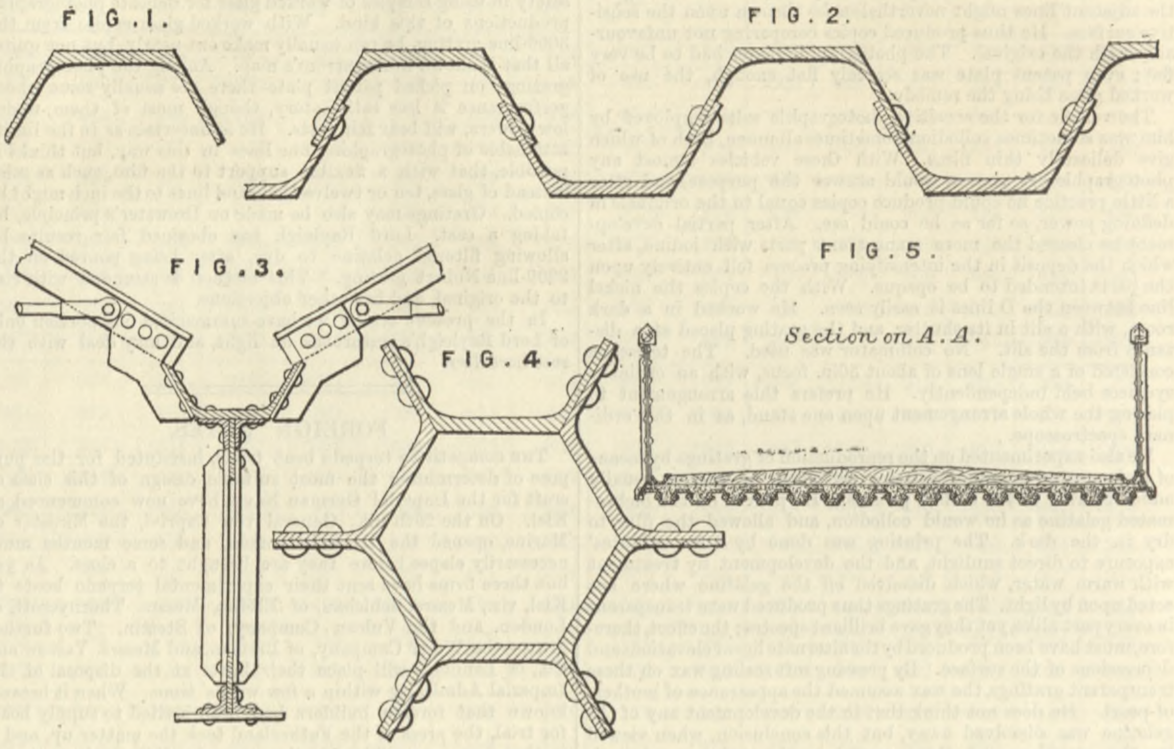
Vertical axles.—For use with vertical shafts, which, in the majority of cases revolve with great speed, the sketch, Fig. 3, shows at a glance the plan usually adopted, viz.:—A ring-shaped reservoir is fixed, surrounding the vertical shaft, below the bearing. This is pierced horizontally by the tubes, which are then bent so as to dip perpendicularly into the oil vessel. A small copper collar is fitted on the axle, covering the oil vessel partially so as to prevent any loss of oil. The method of application may be varied to any extent.

Brackets.—Fig. 4 shows a hanging swan-neck bracket arranged for the same system of lubrication. The bearings may either be bedded firmly in the reservoir, as in ordinary plummer blocks, or may be adjustable so as to be set exactly in line and level with each other. They are provided with the same system of supply in both cases. Some such continuous lubrication is specially needful for machinery which is inaccessible, or at least not easily to be reached at frequent intervals, and especially in cases where belts are liable to be injured by being impregnated with oil.

Loose pulleys.—The system may be applied to any ordinary loose pulley, providing the diameter of the boss is large enough to permit of a sufficient oil reservoir being made inside. In view of the continual motion of a pulley, no plan of oiling them has hitherto been successful, except by hand at frequent intervals, and at great risk unless done when the pulley is stopped. An endeavour has been made to supply this want by a system. The plan shown in Figs. 5 and 6 has been adopted after long study, and has proved by experience in many cases to answer its ends completely. It requires a somewhat large boss to admit of an oil chamber being constructed in it. The centrifugal force driving the oil to the circumference, keeps the ends of the tubes constantly immersed, and consequently supplied with oil, and, moreover, throws back into the vessel the oil which, after flying off from the surface of the spindle, has been collected by the annular grooves in the necks. Each end of the tube has a stud corresponding to it, so that the reservoir can be filled in any position of the pulley by unscrewing the stopper which is uppermost. Leakage in the reservoir is avoided by the use of a leather washer on the studs. The pulleys thus oiled once for all run for months perfectly lubricated and with great cleanliness, all the oil returning into the reservoir. A further advantage lies in the preservation of the belts, which are generally almost impregnated with oil wasted by the pulleys, but which under this system are entirely free from this danger.

Oil boxes.—The application of the system to grease boxes of carriages, locomotives, wagons, tramways, &c., can be easily arranged, using the existing materials. It is sufficient in some cases to apply a half ring of bronze pierced by the cane, which replaces the customary oiled pad or cushion, and is similarly held up in contact with the journal by springs. In other special cases the ordinary bearing is replaced by another bearing of like shape, containing a special arrangement which allows the passage through it of the cane above the journal. Each end of the cane is thus bent down, leaving a sufficient length to descend into the oil box. These plans, which are entirely independent of each other, can be applied singly or together, as may be found suitable. Experience hitherto has proved that no loss of oil can take place through the boss, nor is the outside of the oil box covered with grease, and consequently with dust. Coal and other dust, which accidentally gets into the box by passing along the journal, falling to the bottom, cannot act on the bearing surfaces as happens in the case of oiled pads, where the agglomeration of foreign particles mixing with the oil forms a sort of glue, and in time prevents the oil reaching the bearing surfaces.

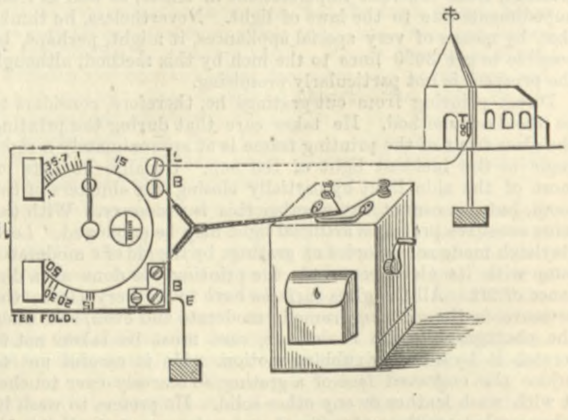
LINDSAY'S TROUGH DECKING.



ABOVE we give a series of engravings showing a new section of steel or iron, together with some of its principal applications to the flooring of bridges and warehouses and other purposes. The section, which is illustrated in Fig. 1 as it is rolled, has recently been patented by Mr. W. H. Lindsay, Paddington Iron-works, W., and is being manufactured by the North-Eastern Steel Company, Middlesbrough-on-Tees. It is rolled in either iron or steel, and in six different sizes varying in depth from about 3¼in. to 7in. The improvement consists in utilising sections of splayed channel steel in which the top table is thicker than the sides. In this way, for any given platform or floor the actual weight of material used is reduced, while as the girders are made up by joining trade rolled sections at a point where the stresses are almost neutral, a single row of rivets is sufficient, and the cost of manufacture is lessened. The strength of the decking when rivetted up is very considerable. Each trough may be treated as a girder, but as each girder is connected to its fellow, it cannot deflect alone, but distributes part of the load to its neighbours. Fig. 2 shows the method of rivetting up the bars, this being the form used for ordinary flooring and decking, for supporting road and railway traffic, and for fireproof warehouse floors, the troughs being filled up with concrete when desired. Fig. 3 indicates the application of the section to roof work, the trough coming in most conveniently as a valley gutter, besides affording a first-rate attachment for the principles. Fig. 4 shows the method of making piles for bridges, piers, and jetties. For light bridges up to 30ft. or 40ft. span, main girders can be entirely dispensed with, the troughs being laid longitudinally as in Fig. 5, with a light parapet or handrail at each side. For still larger spans, the troughs are formed into trusses by the addition of tie rods, and in this way a very economical girder can be constructed. Recently the War-office have adopted Mr. Lindsay's section for building up rifle butts, no stays being required, and it is expected that it may come into use in the same department for bomb-proof covers. No doubt many other applications, such as for sheet piling and cofferdams, will suggest themselves to the minds of our readers, but those illustrated will suffice to indicate the nature and general extent of Mr. Lindsay's invention.

APPARATUS FOR TESTING THE RESISTANCE OF LIGHTNING-RODS.

THE apparatus illustrated by the accompanying engravings consists of a magneto-inductor contained in a wooden box, and a small bridge board sliding into a recess at the bottom of the box. To the latter are affixed a German silver ring, a pointer—which also acts as a battery key—a small galvanometer, four terminals marked L B B E, and beneath the board a constant resistance. It is advisable when erecting a lightning-rod that a loose copper wire be connected to the point of it, running down parallel with it to the base; a connection may then be made to this, which would save the trouble of climbing up to the point each time the lightning-rod had to be tested. For economy sake, when erecting a lightning-rod, two ropes having the same sectional area as the single rope intended to be fitted might be used, both of them being connected to the earth plate and acting as a single conductor. One of the ropes could then have a connection screw fitted at the base T, so that it could be disconnected from earth for testing as required. When a lightning-rod is to be tested terminal L has to be connected to the point of the rod or the loose wire below, terminal E to a reliable earth, and terminals B B to the inductor. Then, by turning the inductor handle and pressing down the pointer on the board, a current is sent through the bridge, and if a deflection be shown on the galvanometer the pointer—still being pressed down—must be turned to the left or right until the needle stands at zero. The graduations round the ring have been so arranged that in this position the pointer will stand at the figure corresponding to the resistance in ohms of the lightning-rod and its earth connection. The board must be so turned before the test is made that the needle of the galvanometer swings freely and stands at zero, and it must be placed



as far from the inductor as the leading wire supplied with the instrument will allow, that the galvanometer may not be affected by the magnetism of the magnets in the inductor. There is a small brass slide S at the back of the bridge board which, by withdrawing, sets the needle into action, and by pushing in lifts it off again. When measuring higher resistances the screw marked "tenfold" must be taken out; the instrument will then measure tenfold the resistances marked on it, *i.e.*, from 1 up to 500 ohms.

Its weight is only 8½ lb. It is made by Messrs. Siemens Bros., who measured with it the lightning conductor on their large factory shaft, which is 135ft. high, obtaining the following results:—When measured from its own earth plate less than 0·1 ohm; taking gas-pipe for earth, 5·3 ohms; taking water-pipe for earth, 0·6 ohm. It need hardly be pointed out that this instrument provides what has been much wanted by electricians, and more especially by those who on land or sea are concerned in the efficiency of lightning conductors.

RAILWAY MATTERS.

FOR the construction of the extensions of the Swansea tramways for the Swansea Improvements and Tramways Company, the tender of Messrs. Wilkes and Co., of Devonshire-square, Bishopsgate, has been accepted.

IN law charges and parliamentary expenses the South-Eastern Railway Company spent no less, during the half-year ended June last, than £23,543, equal to one-seventh of the whole amount paid to ordinary shareholders as dividend.

ONE HUNDRED AND FIVE miles in 119 minutes, or almost 52 miles per hour—deducting stops, 55 miles per hour—was, the *Scientific American* says, the time lately made by a special passenger train on the Illinois Central Railway, being from New Orleans to M'Comb City.

THE Railway Commissioners, with their Registrar, are about to proceed to Ireland to hold sittings at Belfast to hear cases in which the Belfast Central Railway Company, the Great Northern Railway Company of Ireland, and the Glasgow and South-Western Railway Company are the parties.

ON the railways of the United Kingdom there were, at the end of last year, 14,469 locomotive engines, 32,304 carriages, 12,024 other vehicles attached to passenger trains, 434,261 wagons of all kinds used for the conveyance of live stock, minerals, and general merchandise, and 12,072 other vehicles employed in the construction, repair, or otherwise, of the lines and works; the total being 490,661.

A TRACTION engine got into most unusual difficulties on Tuesday week at Desford, Leicestershire. The engine was being taken across the railway at a private crossing, and the wheels became embedded in the ground, and could not be moved. At this moment a mineral train came down the steep bank at speed. The driver did his utmost to stop the train, but it dashed into the traction engine, knocking the front to pieces. The train kept the rails.

THE London and North-Western Railway now includes four separate lines laid upon 114 miles, and three lines upon 28 miles of its railway. The Midland Company has 66 miles of four lines, and 21 of three lines. The Great Northern is laid with four lines for 24 miles, and with three lines for 30 miles. There are now over 400 miles of railway in England laid with three or more sets of rails, and the estimated cost of the widening has been twelve millions.

A CORRESPONDENT has sent us a number of cuttings from current newspapers, showing how frequent are the accidents happening to vacuum and leak-off brakes, that trains supposed to be provided with powerful means of stopping have brakes without a vacuum, so that heavy trains run with the hand brake, which is useless for the fast and ponderous trains of to-day; and of trains overrunning junctions through failure of the vacuum pipes.

IN view of the observations of Major Marindin, in his official report on the Penistone accident, as to the inefficient character of the brake used on the Manchester, Sheffield, and Lincolnshire Railway express, and its non-compliance with the conditions laid down by the Board of Trade, the friends and relatives of those killed and injured in the accident have taken the opinion of an eminent counsel as to the liability of the company. The sufferers are endeavouring to make arrangements for bringing a test action, which will involve some very interesting legal questions.

THE total number of passenger journeys in the United Kingdom, exclusive of journeys by season ticket-holders, was 683,718,137 for the year 1883, or 28,879,842 more than in the previous year. Calculated on these figures, the proportions of passengers killed and injured during the year, from all causes, were in round numbers, one in 5,470,000 killed, and one in 482,851 injured. In 1882 the proportions were one in 5,156,207 killed, and one in 377,185 injured. The proportion, however, of passengers returned as killed and injured respectively in 1883 from causes beyond their own control was one in 62,156,194 killed, and one in 1,032,806 injured.

OUR Birmingham correspondent says: "The result of the agitation by the Walsall Chamber of Commerce for a reduction in the railway rates on smalls has to all appearance been futile. The London and North-Western and Great Western Railway Companies have declined to make any alteration, as also have the Midland Company, who, furthermore, say that the rates are in every way reasonable. The judgment of this pronouncement is, however, questioned by Mr. F. James, the president of the Chamber. He admits that the companies have a right to charge for smalls, but he pointedly asks why should a parcel of 3 cwt. be charged at the rate of 24s. a ton, and one of 2 cwt. at 19s. a ton?"

A LOCAL paper gives the following, relating to the undignified position into which a locomotive was placed by bad brakes:—"A singular mishap occurred on the Lancashire and Yorkshire Railway to the train leaving Bolton for Blackburn at 6.47 on Saturday. At Lower Darwen the train was stopped for the collection of tickets, and when the train should have resumed its journey, the engine driver could not take off the vacuum brake. Two engines had to be brought from the nearest locomotive shed, and pushed the train some distance, after which the engine attached to the train was dragged away with the brake still on, and the train proceeded to Blackburn, half an hour's delay having been caused."

THE report of the Channel Tunnel Company for the half-year ended 30th June states that, in consequence of the opposition to the second reading of the Bill promoted by the South-Eastern Railway Company in the past session of Parliament, it has been found desirable to postpone for the present any renewed application to Parliament. The directors think it expedient for the company to preserve its existence, and to await a more favourable moment for again applying to Parliament. The French company, who hold from the Government of France the concession for the construction of the French portion of the tunnel, have also determined to adopt this course. A return will be made to the shareholders of £3 per share on shares on which £10 have been paid, and £13 per share on which £20 have been paid, subject to being recalled when necessary.

ACCORDING to the quarterly returns published by the French Minister of Public Works, the total length of railways in Algeria and Tunis was, at the end of the first quarter of the current year, 1035 miles, of which 320 miles belong to the company which works the lines from Algiers to Oran and from Philippeville to Constantine, 288 miles to the Bona and Guelma Company, 232 miles to the East Algerian Company, 155 miles to the Franco-Algerian Company, and 50 miles to the West Algerian Company. The total receipts of these railways for the first quarter of the current year were £148,920, this being equivalent to a mileage rate of about £144. The receipts were about the same for the corresponding quarter of last year, but there is likely to be a considerable increase within the next few years, as the various sections of lines are rapidly being connected with one another, and this will make an immense difference in the traffic.

A SOMEWHAT unusual feature in the July accidents on American roads for a summer month was the occurrence of no less than three boiler explosions. Whatever may be the reason, and it must be confessed that authorities on this point differ very widely, it is beyond doubt a fact, says the *Railroad Gazette*, that the boiler explosions are generally more frequent in cold weather than during the summer months. Last month three were recorded, and it is possible that a clue to this may possibly be found in the fact that we are now passing through a period of depression in business and light earnings, when too many railroad companies are apt to neglect repairs of rolling stock, cutting down their shop expenses to the lowest possible point. This practice of course saves money only temporarily, but it is nevertheless often resorted to, and a careful comparison of the accident record for a number of years shows that there has been invariably an increase in accidents resulting from defects of equipment, and especially from defects in locomotive equipment, after a period of light earnings.

NOTES AND MEMORANDA.

THOUGH magnesium has no action upon pure water, it decomposes it in presence of a trace of platinum chloride.

ALUMINIUM, nearly pure, has a density of 2·786; its electric resistance is 1·96 times that of pure copper wire of the same length and diameter. For wires of equal length and weight, the resistance of aluminium is a little less than that of pure copper. The addition of a small quantity of aluminium to copper largely increases both the mechanical and the electrical resistance.

FOR a powerful magnet Sig. B. Ricco, of Palermo, rolls a long band of sheet iron around a nucleus of soft iron, insulating the different layers of the band by oiled paper. One pole is connected with the nucleus, to which the interior extremity of the band is soldered, and the other is connected with its exterior extremity. The current, in traversing the band, magnetises not only the nucleus, but also each layer of the band, which thus plays the double *rôle* of conductor and of magnetic substance, thereby condensing the lines of force, and producing a great concentration of power.

DURING the week ending August 16th, 1884, in thirty-one cities of the United States, with an aggregate population of 7,353,300, according to the official returns published in the *American Sanitary Engineer*, there died 3249 persons, which is equivalent to an annual death-rate of 23·0 per 1000. In the North Atlantic cities the rate was 22·2 per 1000; in the Eastern cities, 23·3; in the Lake cities, 21·8; in the River cities, 23·4; and in the Southern cities, for the whites 20·4, and for the coloured 30·4 per 1000. The deaths under five years of age were 52·6 per cent. of the total mortality, the proportion being highest in the Lake cities—viz., 65·0 per cent.

THE following figures are from a paper contributed by M. Simonin to the Paris Société de Statistique, showing the comparative number of deaths from accidents in mines in some of the countries of Europe:—

Country.	Number of miners.	Number killed per 1000.
Saxony	15,673	3·39
Prussia	—	2·89
Belgium	76,697	2·38
England	558,817	2·18
Austria-Hungary	41,133	2·10
France	105,742	2·09

MR. R. S. NEWALL, writing on an electrical rainbow, says:—"I visited the South Foreland, to see the experimental lights now on trial there, on Saturday night, August 30th. We were walking across the fields from the lights towards the observing hut No. 2, a distance of about a mile and a-half. There was a fog more or less, and a shower of rain as we were approaching the hut, and every time the electric light from A tower revolved, a rainbow, very like a faint lunar bow, made its appearance. I could not see any prismatic colour, and the bow was only produced by the large electric light, with carbons of 1⅛in. in diameter. There was no bow visible from the old light, which has carbons of about ⅜in. square, and none from either the gas or oil lights."

AS a commercial centre of the East, Smyrna now ranks next to Constantinople, having a business value of 220,000,000f. per annum, of which over half is for imports. The English trade figures for 100,000,000f.; France for 40,000,000f.; Austria, 19,000,000f.; America, 18,000,000f.; Germany, 6,000,000f.; Italy, 8,000,000f.; Russia, 4,000,000f.; Roumania, 1,800,000f.; Holland, 7,000,000f.; Belgium, 2,000,000f.; Turkey, 8,000,000f.; and Greece, 1,000,000f. The city itself contains 250,000 inhabitants, while the *vilayet* of which it is the capital has about a million, of which 600,000 are Mussulmans, 312,000 Greeks, 40,000 Armenians, 30,000 Jews, 13,000 Catholics, and 5000 Europeans. In the *vilayet* of Smyrna, as indeed throughout the whole of Asia Minor, the Turkish population is gradually decreasing, while, on the other hand, that of the Greeks is as rapidly increasing.

A MONEY-WASHING machine will soon be amongst the hygienic requirements. *Science et Nature* has raked up another danger in the matter which collects on coins which have been a long time in circulation. M. Reinsch, of Erlangen, has devoted much study to this matter, and has investigated old and recent coins of all metals from all the European States. Everywhere he has found micro-organisms of Algæ and Bacteria. Scraping away the matter which accumulates in the interstices of the relief with a needle, and placing it in a drop of distilled water under a microscope of 250 to 300 diameters, he found fragments of textile fibres, numerous starchy granules, especially of the starch of wheat, globules of grease, some unicellular Algæ, &c. But when a microscope of greater power was used, Bacteria were found among this detritus. There were long Bacteria with a vibratory or spiral movement, as well as those of a globular shape. Sometimes both forms were found on one coin, but as a rule each form was found separately.

A NEW process for working lead fume into litharge and red lead has been described in the "Journal" of the Society of Chemical Industry. The fumes evolved from the working of galena contain lead sulphate, sulphite, and oxide, arsenic and antimony, also lead sulphide, and, when zinc ores are present, zinc oxide. The lead fume is mixed with sodium carbonate or hydroxide, and roasted. The roasted product is then washed, whereby sodium sulphate and sulphite, and sodium compounds containing arsenic and antimony, are separated. The lead compounds are converted into lead oxide by this treatment. The lead fume may be boiled also with a solution of sodium carbonate or hydroxide, lead carbonate and hydroxide being formed, while arsenic and antimony are dissolved. The washed precipitate is then roasted. In the presence of zinc compounds they are removed by boiling with sulphuric acid. If lead sulphide be present, it is necessary to boil first with a solution of calcium hypochlorite. Sodium sulphate is recovered from the liquors after separating arsenic and antimony.

THE following have been published by a German contemporary as formulæ for some wood stains, which may be put up in a dry form, and when wanted for use may be readily dissolved in water:—Oak wood: 5 kilos. of Cassel brown, 0·5 kilo. of potash, and 10 kilos. of rain-water, boiled together for an hour, the whole strained through a linen cloth, and the clear, dark-coloured liquid boiled to a syrupy consistency. Walnut wood: A decoction of Cassel brown, 3 kilos.; potash, 0·3 kilo.; and water, 7 kilos.; the whole strained through linen, and during evaporation to syrup 2·5 kilos. of extract of logwood added. Mahogany: A decoction of extract of Brazil wood, 3 kilos.; potash, 0·25 kilo.; and water, 3 kilos.; to which, before evaporating to syrup, 150 g. of eosine are added. Ebony: 5 kilos. of extract of logwood boiled with 11 kilo. of water, and, when near the syrupy state, 300 g. of iron nitrate added; evaporated to a syrup under constant stirring. All the above stains are brought into a dry condition by running the respective syrups into trays of sheet iron, with low rims, in which the syrup hardens, and is afterwards broken up and ground.

IN a recent Embassy report on Austrian industries, it is mentioned that the chief steel production is carried on in Styria, Carinthia, Upper Austria, Bohemia, the northern portion of Moravia, and lastly, in Silesia. Great progress has been made in Austria in the manufacture of Bessemer steel. In 1880 there were ten furnaces which gave 885,100 metric centners; in Hungary this industry is limited to two places, Reschiza and Diosgyor, where the annual production is about 128,500 metric centners; while, in 1880, the Austrian production of Martin steel was 204,000 metric centners; cast steel, 70,000 metric centners; steel for safes, 40,000 metric centners; and raw steel, 30,000 metric centners. Styria and Lower Austria are the greatest producers of wire, and Carinthia of iron plates. Hardware is produced on a large scale in Austria, in Styria, Bohemia, Moravia, and Silesia. The manufacture of alloyed metals is chiefly in Lower Austria; Vienna is famous for its bronze lamps and other articles made of metals. Machine building is chiefly carried on in Vienna and the district around; there are 323 machine works employing 20,000 persons, nearly all in Lower Austria and Bohemia.

MISCELLANEA.

ON and after Saturday, the 20th of Septemer, the Health Exhibition will be closed at 10 p.m. on Saturdays.

THE "Diploma of Honour," the highest award at the Crystal Palace Exhibition, has been gained by Mr. Alexander Dick for his exhibits of Delta metal.

AT the Amsterdam Exhibition Messrs. Henry Pooley and Sons have been awarded gold, silver, and bronze medals for their various kinds of weighing machines.

THE latest date for sending in applications for space in the International Inventions Exhibition has been extended from the 1st of October to the 1st of November.

THERE were 55,971 visitors to the Health Exhibition on Monday. This, with 56,349 on Saturday, brought the total number since the opening of the Exhibition on the 8th of May, to 2,753,027, or 49,976 more than visited the Fisheries Exhibition during the whole time it was open.

THE *Scientific American* notes that an inventory of the estate of Mr. Cyrus H. McCormick, the great manufacturer and inventor of reapers and mowers, has been filed in the Probate Court of Cook County, Ill. The total is not far from 20,000,000 dols. The executors furnished a bond for 30,000,000 dols.

THE new plant now being put down by Messrs. Bolckow, Vaughan, and Co., at Eston, includes two Siemens steel melting furnaces. This is to enable them to supply either Siemens, Bessemer acid, or Bessemer basic steel for any purpose. There will soon be six works in the north-eastern district where Siemens steel ingots will be procurable. The anomaly of east coast shipyards and bridge yards being supplied with steel from Glasgow will very soon come to an end, and even a healthy competition is likely to follow for orders within reach of both.

ON Saturday, 6th inst., Mesrrs. Edward Finch and Co., of Chepstow, ran a trial trip of the screw tug boat, Stormcock, built to the order of Messrs. Wm. Williams and Son, of Newport. Her principal dimensions are:—Length, 95ft.; breadth, 18ft.; depth, 10ft. 1½in. She has compound surface condensing engines of 95 nominal horse-power, and an enormous boiler for a working pressure of 100 lb. per square inch. She left Chepstow at 7.45 a.m., made a very successful run to Ilfracombe, started on her return journey, and ran to Newport in three and a-half hours. This is said to be the fastest and most powerful screw tug boat on the Bristol Channel.

MR. W. CROOKES, F.R.S., and Drs. W. Odling and C. Meymott Tidy, reporting to Colonel Sir Francis Bolton, official water examiner for the metropolis, on the composition and quality of daily samples of water supplied to London last month, state that of the 168 samples derived from the mains of the seven metropolitan water companies taking their supply from the Thames and the Lea, "the whole were, without exception, clear, bright, and well filtered. The excellence of the water supplied to the metropolis during August was indicated by its state of aeration, and by its freedom from colour and from any excess of organic matter. Further, its perfect filtration was evident by the absence of even a trace of suspended matter in any one of the numerous samples submitted to examination."

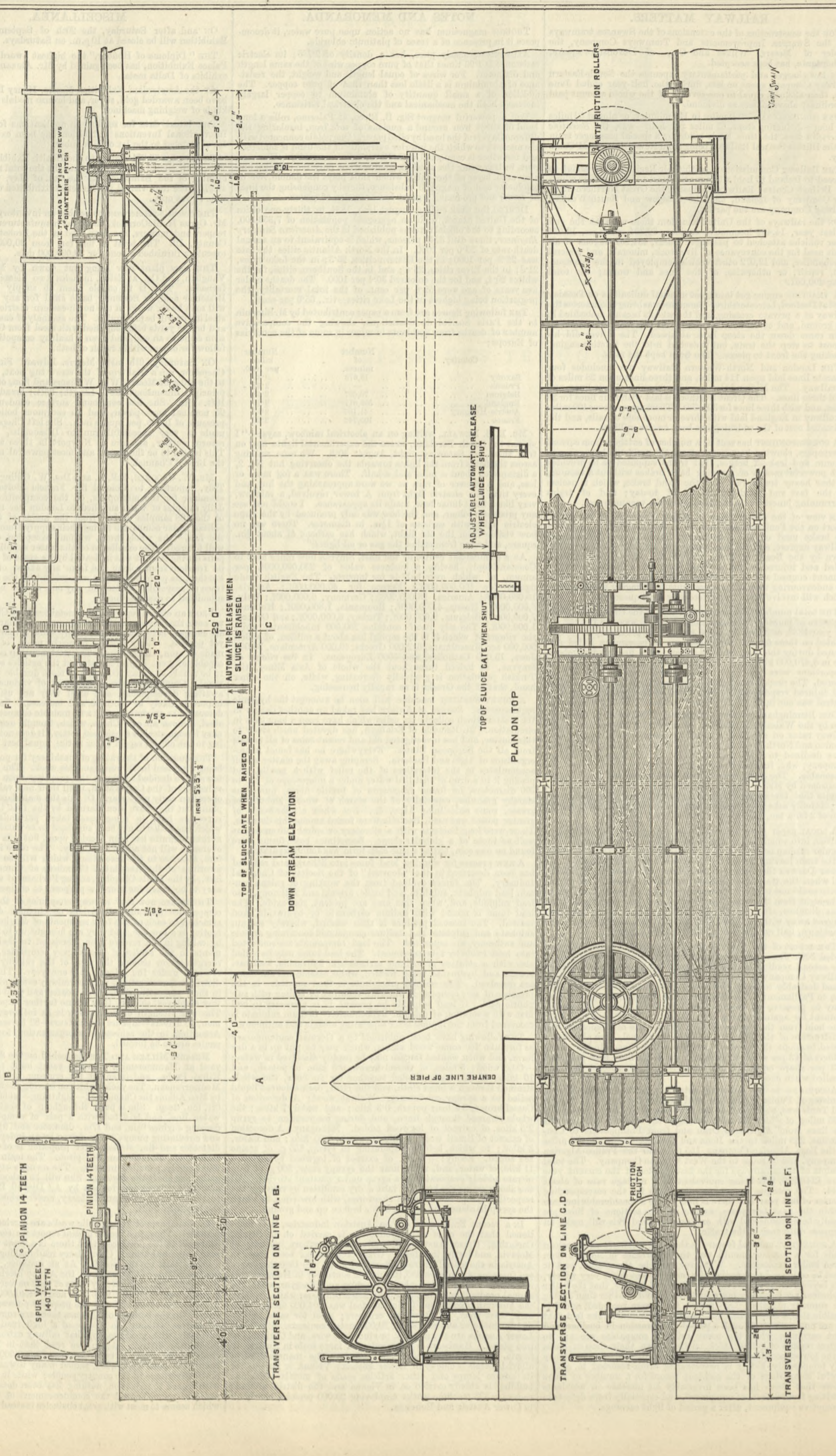
FROM an official report on the metal trade of Chin Kiang, China, we note that foreign metals enjoy great popularity there, as they are cheaper, better, and more easily worked than any the Chinese yet possess. Many articles formerly made of wood are now made of iron, tin, or wire. The workmanship is often rough, and capable of great improvement; but the articles so made are found to be nearly as cheap as, and far more durable than, the same in wood. China possesses great stores of various kinds of metals awaiting development, and until they are utilised the foreign import is likely to continue and increase. Imported steel has decreased in amount, having a formidable competitor in the Wu-hu steel, famous all over China, which, though dearer than the ordinary foreign steel, is considered better. It does not, however, according to the official report under notice, equal best English steel.

THE question of the rating of machinery for poor-law purposes is being discussed in Birmingham this week. The overseers of that town have decided to assess the property upon the independent valuation of the Corporation, until their new valuation comes into operation early next year. Of this the manufacturers do not complain, but they have been alarmed by the fact that the assistant surveyors have in some cases taken particulars of machinery, which has hitherto not been supposed to be rateable. At present nothing definite has been decided upon, but it is trusted that the overseers will not adopt this policy. The more importance, therefore, attaches to the resolutions which will be presented at the meetings of the Associated Chambers of Commerce on the 30th inst., by the Leeds Chamber, asking Parliament to limit the machinery to be taxed for poor-law purposes to engines and shafting.

THERE are now four railway companies of the French army—compagnies militaires d'ouvriers de chemins de fer—one being attached to each of the four regiments of Engineers. Their peace footing is a low one, and they are brought up to their war strength by calling in the reserve men dismissed to their various employments in the service of the railway companies. Under the new reorganisation scheme the men of the railway troops are to be retained under the colours only one year. They are then to be distributed amongst the various railway companies, further trained in their respective duties, but treated and paid like the other railway employés, so that they are no further expense to the State. The war strength of a company is as follows:—Six officers, 300 men, 50 drivers—sapeurs conducteurs—82 horses, and 18 carriages. According to the scheme of reorganisation, four additional companies are to be formed.

MESSRS. MILLER AND TUPP launched on the 8th inst. from their yard at Hammersmith a steam yacht built for his Excellency Kilmi Pasha, and intended for cruising in the Bosphorus and Mediterranean. The yacht, which on leaving the ways was christened by Mrs. Adams the Chemcheck—Lightning—is 65ft. long, 12ft. beam, 6ft. 6in. deep. She is built throughout of teak, coppered to the water line, and is fitted with a pair of compound surface condensing engines 9½in. and 17in. diameter and 9½in. stroke, the air and circulating pumps being driven by an independent engine 5in. diameter and 4in. stroke. Her propeller is of gun-metal, three-bladed, 4ft. diameter and 6ft. pitch. The main saloon is forward, handsomely panelled in teak. The owner's state room and the galley are abaft the engines. She will be schooner rigged, and is now being fitted out for sea by A. Djernil Bey, naval attaché to the Imperial Ottoman Embassy, under whose superintendence she has been built.

IN some parts of Italy public works are carried out in a peculiar manner. Thus, in a recent official report we read, with regard to State aid to the provinces, that there is a great want of additional road communication. Compulsory road-making is in many places a severe task on the people. As an instance, Castelsaraceno, a poor commune of 2000 souls on the Alpine heights of Latronico, is required to construct twenty miles of road on very rough and friable ground, and this road will cost nearly £40,000 sterling—a sum equal to the entire value of the property possessed by the inhabitants! On the borders of Cosenza there are some thousand square kilometres without the vestige of a high road; and it is stated obviously with good reason, that railway extension would much benefit the district. Again, we read that in Liguria obligatory road-making, which in two years cost £8,520,000, and of which the communes paid £5,120,000, ruined many towns without bringing much advantage to the country people; while in the same province, with regard to irrigation, nothing has been done for the past fifty years or more, beyond the commencement of the Lunese Canal, which seems to meet with great obstacles instead of encouragement.



LOUGH ERNE DRAINAGE.—LARGE CONTROLLING SLUICES AT BELLEEK.

MR. F. G. M. STONEY, M.I.C.E., WESTMINSTER, ENGINEER.

(For description see page 213.)

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

C. E.—*The patent has still several years to run. Nine, we believe.*

J. K.—*You can obtain what you want from Messrs. Crosby Lockwood and Co., Stationers'-hall-court.*

J. P. (Clydach).—*Nearly all compound marine engines have the cranks at right angles. If you will turn to any of the back volumes of* THE ENGINEER *you will find numerous examples of the diagrams from such engines.*

W. D.—*So far as we can understand your rough sketch, there is no reason why your little hot air engine should work. There are no valves for the admission or discharge of air. We do not understand what you mean by a distributor, or what its functions are.*

E. Z. D. (Bilbao).—*If your boats are heavy and the screws are small, the slip is sure to be large. It is, however, quite impossible for any one to say what change that you can carry out would be successful. If you increase the area or the pitch, you may, it is true, reduce slip, and at the same time so lock up the engines that they can no longer develope the requisite power. You would then lose in speed and probably save in fuel. Again, if you put in a screw with smaller pitch, your engines will run faster than they do now, which may not suit them. Your only plan is to experiment, and we should advise you to begin with a screw 10ft. pitch and 7ft. in diameter, augmenting the blade surface by about 10 per cent.*

GRINDING SULPHUR.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers tell me of a machine which will grind or pulverise sulphur—from crystals—to an impalpable powder? A. D.
Guildford, September 17th.

TURBINES.

(*To the Editor of The Engineer.*)

SIR,—Could any reader kindly inform me in your columns who is the maker of a turbine in which the revolving wheel is in two parts, which can be closed together vertically, so as to suit varying supplies of water?
Barnes, September 16th. E. W. S.

WATERPROOFING CLOTH.

(*To the Editor of The Engineer.*)

SIR,—Will any of your readers kindly tell me the proportion of chemicals to water in the sugar of lead and alum process of waterproofing, whether both or either of the solutions should be used hot, and the length of time immersion in them should last? All the books upon the subject that I have been able to get at merely say, "Treat your cloth alternately with solutions of sugar of lead and alum"—a sort of instruction which leaves me still A GROPER.
September 16th.

A CORRECTION.

(*To the Editor of The Engineer.*)

SIR,—In your last week's impression your correspondent states that the Lewis Merthyr Collieries are about to be sold to D. Radford and Co., and that an arbitration now sitting is to settle the price of purchase. As there is not a vestige of truth in such a statement, it is calculated to do us considerable injury, and we must request you to take the earliest opportunity to correct such a statement. It is quite true that a reference has been made to an umpire under an old contract to settle the price to be paid by one of our customers for his next year's supply, which probably has misled your informant. At the same time we do not hold him excused for his carelessness. W. H. WILLIAMS.
London, September 15th.

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DEATHS.

On the 16th July, at Perth, Western Australia, the Hon. JAMES HENRY THOMAS, M.I.C.E., J.P., Member of the Legislative Council and Director of Public Works.

On the 10th September, at Rome, suddenly, WILLIAM JOHN JONES, Assoc. M. Inst. C.E., aged 35.

THE ENGINEER.

SEPTEMBER 19, 1884.

THE KARTOUM CAMPAIGN.

IT is something to reflect that we are unlikely to do any harm in discussing the coming Egyptian campaign. It can hardly be supposed that any one could, even if they would, convey information to the Mahdi or his lieutenants. Unfortunately, the freedom engendered by the sense of security against possible mischief is considerably tempered by the fact that we know but little in this country, as in some matters we are making preparations with uncertainty as to whether they will be utilised at all, or whether some alternative plan may be followed to which they are not applicable. However, the general state of affairs may be readily described. So far as we know, General Gordon and Colonel Stewart are holding their own, and something more, at Kartoum, inasmuch as Colonel Stewart is to attack Berber, 200 miles from Kartoum, and then endeavour to bring in the garrisons from towns in the south, to Kartoum. The last messages received encourage the belief that things have latterly rather improved than otherwise, and it may be added that at no time were they quite so bad as was commonly supposed. Probably Stanley and Baker's statements have relieved many minds. To be told merely that General Gordon himself could leave Kartoum was not at all to the purpose. Under no circumstances would General Gordon abandon to their enemies those who had been faithful to him. We should be sorry to think that any English general would do so. We could best conceive such a thing brought about by orders from home, but even in this case we should be confident that if General Gordon felt that his orders forbade his remaining out in his official position, he would resign, and remain out in a private capacity, which would come in his case to nearly the same thing, seeing that the Arabs would not recognise the difference, and it is a question whether the opinion of the British public would not be the same as that of the Arabs. To be told, however, that General Gordon could not only leave, but also take his garrison with him, is a totally different matter—so different, indeed, that except for the consideration of other garrisons in the Soudan, it would be the fulfilment of the entire object that was said to be the one in view. Hence it seemed scarcely credible that this could be so when first given out; yet Stanley's statement is well supported, seeing that General Gordon himself has endorsed it. We happen to have seen a copy of a private letter, the last received from him, we believe, before the road was blocked. In this he states that he has no fear of defeat, and that starvation is the means that will and must be employed against him. He had, however, provisions for some months to come. He spoke of the encouragement the enemy had received when the news of Baker's defeat reached them; but, black as he admitted things looked, he wrote with confidence. General Gordon has a faith in God that keeps him from ever desponding or yielding to circumstances, but he certainly avails himself of any means in his reach to accomplish his object, and he here states his belief that he could escape up the river, that is south towards the Congo with the blacks, while Colonel Stuart might take the whites across country to Suakim. This he stated he would do at once if only he knew for certain that the Government had decided not to relieve him; but he expressed doubts of his hearing what conclusion they might arrive at, owing to the telegraph line being cut.

Now we come back to the fact that Government is going to relieve him, and the question must naturally be raised as to what is the object to be carried out. That General Gordon could not be abandoned under any circumstances, we think all will admit. He was appointed Governor-General of the Soudan by the English Government, a fact that does not seem to have been taken in by everybody. To abandon him under these conditions would be the same thing in principle as it would be to abandon any other Governor-General, say, the Governor-General of India; and, as we have shown, it would have been to little purpose to cancel his appointment, and recall him in theory, if we practically left the same General Gordon in the same position. His own determination would then have done duty for a Government order. His personal influence would have replaced his commission, and, if we mistake not, English sympathy would have been no bad substitute for the judgment of an English Government, for it would equally have made operations in his support imperative sooner or later. Still, such operations are now being undertaken, we are glad to say, by our Government; but, we are compelled to ask, with what object? If it is merely to bring down General Gordon and all who are faithful to the rule of the Khedive, it is only doing what General Gordon expected to do, and what Stanley declared he could do, without our assistance—in a safer and more sure way, no doubt, but still, only the same operation. This additional security is a small result to obtain at so large a price as a formidable engineering campaign, for this is what we now have to face. Surely our Government must have something better in view than the abandonment of Kartoum and all the country, of which it may be regarded as the capital, to anarchy and slaughter. It has been stated that to hold the country is safer and cheaper, as well as more consistent with the well-being of the inhabitants and the stability and good faith of the Egyptian Government, than to withdraw all the garrisons and subjects of the Khedive. It is a little difficult to arrive at General Gordon's own judgment on this question, but the declaration that we should have to "smash the Mahdi" hardly describes the mere withdrawal of all that potentate's enemies. The expression is doubtless crude and informal, but it at all events implies a very vigorous and forcible form of "Rescue and Retire," and in truth nothing is more sure to engender future bloodshed and misery than measures based on the wish to escape future responsibility with bare decency.

To come to what is more particularly within the scope of THE ENGINEER, the actual preparations and possible operations of the campaign. Kartoum lies about 15½ deg. north latitude, Cairo being about 30 deg. The distance as the crow flies may be about 1000 miles, or 1500 by the course of the Nile, speaking roughly. Suakim, which is about 19 deg. north latitude, is about 250 miles from Berber and over 450 from Kartoum. Either route has its difficulties. The Suakim and Berber route is not impracticable at all for small parties, but with a large force the difficulties, especially in the way of water supply, become enormously increased. The difficulty of conveying artillery need hardly be discussed, as by neither route does it appear to be contemplated that anything beyond mountain guns should be employed, and we are left in doubt as to them. We cannot hear of any guns going out from England, though we believe some ammunition for mountain guns has been sent.

By the Nile the water supply question is disposed of, but other difficulties are abundant. The journey will be trying in the extreme. The expedition could doubtless be carried for some distance up the Nile without any difficulty, partly by rail and by steamers. The operation becomes a more serious one, however, owing to the provision that has to be made for the journey along the higher part of the river. As our readers have perhaps heard, this provision consists of a fleet of 800 small boats, which are being shipped out from England as fast as possible. Each boat is about 30ft. long and 7ft. broad, and draws from 17in. to 19in. of water when carrying her full load of fourteen men and provisions for 100 days. She has twelve oars, six punting poles with spikes, and two masts and sails. The boats are made of pine—light and fairly strong; the shape is considered good. They trust more to drawing little water than to any power to resist contact with rocks in the stream. These 800 boats would provide for about 8000 men. The original force was to be 5000; with Lord Wolseley's appointment, and the decision not to employ the Khedive's troops, it grew to 7000, and has since further increased. It is intended apparently that the men should row themselves. This will be no light task. The Nile is estimated as running about 2 to 3 knots an hour generally where the water is smooth. In some of the rapids it runs from 10 to 12 knots an hour. It will be seen, therefore, that it can only be contemplated to ascend a very limited portion of the river by such means, though we cannot say how much. At one part of the river, about 20 deg. north latitude, there is a short piece of railway running from Argash to Sarras, which avoids one troublesome part of the river beset with islands and rapids. A little above this comes the cataract of Hanneck, or Third Cataract as it is called, which some consider the worst one to pass; then comes Old Dongola, and then Ambukol, from which point the Nile makes a wide bend doubling north again for a great distance before turning south to Berber. Eventually a south-west course leads to Shendy, and after passing the Sixth Cataract to Kartoum. The work of rowing is likely to be very severe, the temperature as Kartoum is approached being from 94 deg. to 106 deg. Fah. in the day in the shade, and at night falling to a minimum of from 50 deg. to 31 deg. It is possible to avoid the last part of the river by marching from Ambukol to Shendy by a chain of wells; indeed there are two routes, but the distance is about 200 miles, and all the difficulties of the desert would be aggravated by starting from a point so far up the river and so difficult to supply as Ambukol. When all difficulties are considered, it is not to be wondered at that the route from Suakim has been preferred by many, and that it is questioned whether the boats now leaving England will ever be seen on the upper reaches of the Nile. A camel corps is now being organised by 1100 cavalrymen, now to be sent out from England. This would, of course, act from Suakim. The stores of food that are being sent out for the boats deserve commendation. Everything is packed in small tin boxes—beef, potato-powder, marmalade, jam, tea, salt, tobacco, medical comforts, &c.; no coffee, because it will not keep when ground. For other work, the compressed hay-trusses, on an excellent suggestion of Mr. Steele, the officer who is superintending the details of packing, are cut by a band saw into smaller packages easily lifted. The main question of this campaign is *food*. How difficult is the supply we think is apparent from the dependence that is being placed on the date harvest to enable 3000 Arabs to work at the cataracts hauling the boats up them. Whether by the Suakim route or the Nile it is the same question. By river the soldier carries his provisions wasting as he goes into a desert. By land the camel does the same. In a case of life and death the loads might be continually made up to the full on the minimum number of camels, and those relieved of their loads killed, to push the expedition the maximum distance on its supply of food; but this would be a horrid expedient, and only of limited application.

Altogether the campaign will be interesting, we should judge, mainly from the point of view of carriage and supply. It will be a kind of interest that may involve much suffering we fear. Let us hope that a commensurate result may be obtained.

THE STOCKPORT TRACTION ENGINE TRIALS.

THE trial of traction engines at Stockport, described in our last impression, is noteworthy in more respects than one. The Royal Agricultural Society, after testing steam engines year after year, unwisely arrived at the conclusion that no further improvement in agricultural engines was possible, and refused to carry out any more trials. The last competition of the kind was held at Cardiff twelve years ago. In 1871 a very important and interesting trial of traction engines took place at Wolverhampton; but since 1872 the steam engine has been a dead letter so far as the leading Agricultural Society in the world was concerned. The reason why has been very plainly stated. Engineers with great influence at the Council table have said plainly that, having got all the prizes they needed, they did not see why the competitions should be continued, because it was more than probable that younger firms, profiting by their experience, would beat them, and so deprive them of their laurels. This, we need not say, is not the spirit in which the business of what is really a great public body should be conducted. To all remonstrances the Council have been deaf; and we see now with pleasure that their hand is being forced, and that if the Royal Agricultural Society of England will not hold competitive trials of steam engines, other bodies will, and that competitors will be found in abundance, even among the most influential members of the Royal Agricultural Society itself. It is further to be borne in mind that a prize gains nothing in value by antiquity. The purchasing public will not attach one-half the value to a medal won a dozen years ago that it will to a prize taken yesterday. The engineers who have been content to rest on their laurels will find on examination that they are but withered and worthless leaves. No one now believes that the best results obtained by racers at Cardiff are at all comparable with those obtained by compound engines in the present day. We have before us figures to which no exception can be taken, which show that the weight of water used per horse per hour by the ordinary commercial engines made by Messrs. Garrett, of Leiston, differ in amount by only a fraction of a pound from the weight used by the best engine in the showyard at Cardiff, in 1872. The boiler of the Cardiff engine was, of course, better than that of a commercial portable, but in that respect alone was it more economical. We mention this to show how great has been the advance made in the last twelve years. The compound engine again bids fair to become the most popular portable and semi-portable engine of the future; and we do not think that makers of this type will rest satisfied much longer without further trials such as can be carried out just as well by any other body as by the Royal Agricultural Society. The first step in the right direction has been taken by the Royal Manchester and Liverpool and North Lancashire Agricultural Society, which, as we have already stated, offered a gold medal for the best traction engine. To show how highly this prize was appreciated, it is enough to say that no fewer than fourteen engines were entered for competition. Indeed all the principal makers of traction engines in the kingdom were represented.

The trials were, on the whole, very instructive and suggestive. The first point which strikes us is the misleading nature of the term "nominal horse-power," and its effects on the trial. On the first day an allowance of 20 lb. of coal per nominal horse-power was served out to each engine, and with that it will be remembered the driver had to run with a load of 4 tons as far as he could—until, in short, his engine stopped for want of steam. Nominal horse-power is by the Royal Agricultural Society calculated at the rate of 10 circular inches of piston per horse-power. Now, Messrs. Aveling and Porter and others put in engines with 9in. cylinders, and $\frac{9^2}{10} = 8$ in round numbers. These engines were allowed 160 lb. of coal. Messrs. Fowler put in an engine with an 8½in. cylinder, which is rated by the foregoing rule at 7-horse power, but this engine also had had 160 lb. of coal served out to it. This was obviously wrong if the area of the piston was the basis on which the coal was weighed, and we have no doubt that it was, because the engine of the South Durham and North Yorkshire Steam Cultivation Company, which had a cylinder precisely the same size as that of Messrs. Fowler, was only allowed 140 lb. of coal. We fail to see any good reason for making this distinction and handicapping the Durham firm so heavily. Mr. Foden put in a 6-horse power engine, with two 5⅝in. cylinder, 10in. stroke, and got 120 lb. of coal. The weight of this engine is 9 tons 16 cwt., as against 12 tons 12 cwt. that of Messrs. Fowler's compound engine. The load given to both engines was precisely the same. Mr. Foden's engine, with 120 lb. of coal, made 10⅝ laps. Messrs. Fowler's compound engine, with 160 lb., made 12⅓ laps. Foden's engine burned 11·3 lb. per lap. Fowler's engine burned 12·97 lb., or 1·67 lb. per lap more than Mr. Foden's engine. The total load moved by Fowler was 16 tons 12 cwt.; by Foden, 13 tons 16 cwt. So far as the actual performance in the trial ground is concerned, Foden's engine, with two non-compound cylinders, was a more economical machine than Fowler's double cylinder compound engine. It may, of course, be urged that Fowler's engine had not load enough, and would have shown to more advantage with a greater weight behind it. We scarcely see the logic of this. It is true that the weight hauled might be increased, but then the distance run must also have been reduced. There is certainly no triumph in this trial for the compound system.

We may now compare the performance of the single cylinder engines. That of Messrs. Aveling and Porter weighed 12 tons 16 cwt. It received 160 lb. of coal, and it hauled its four tons load, and it made 9⅝ laps, and burned 16·7 lb. of coal per lap. McLaren's, also a single cylinder engine, and weighing 12 tons 18 cwt., made 13 laps, and burned 12·3 lb. of coal per lap. It therefore beat Fowler's engine by ·67 lb. per lap, and was beaten by Foden by 1 lb. per lap. Fowler's single cylinder engine, with 160 lb. of coal, although rated as a 7-horse power, made 9¼ laps, and burned 17·25 lb. per lap.

When we turn to the second day's trials of the selected engines we arrive at some remarkable facts. Each engine was now allowed 10 lb. only of coal per nominal horse-power, steam being previously raised to 100 lb. pressure; the working pressure being in all cases 125 lb. Mr. Foden made 8⅝ laps, being in round numbers 7 lb. per lap. Fowler's compound engine also made 8⅝ laps, burning in round numbers 9 lb. per lap; the extra weight moved being 2 tons 16 cwt. of non-paying load. In this case Mr. Foden's triumph was complete. Messrs. Aveling and Porter's engine made 9⅝ laps with 80 lb. of coal, or 8·31 lb. per lap. McLaren's 6-horse power engine made 8 laps with 60 lb. of coal, or 7·5 lb. per lap. We do not know on what system the judges founded their decision; they must, however, have taken into consideration much besides economy of fuel, because Mr. Foden's engine was more economical than any other engine tried. It will be seen that the performance on this the second day was far better than that of the first day. Thus Messrs. Fowler required within a small fraction 13 lb. per lap on the first day, and only 9 lb. the second day. The difference is due mainly to the fact that on the first day steam had to be raised from cold water, and a preliminary run had to be made by the engine alone, neither of which things was demanded on the second day. Again, it must not be forgotten that the personal element —in other words, the skill and coolness of the driver—has much to do with the results, not only economical, but general, obtained under such conditions of test as those ruling the competition at Stockport.

We are not at all surprised to learn that the competitors are all dissatisfied. Indeed the matter cannot possibly be left where it is. Mr. Foden by no means takes rank as a large builder of traction engines. He is the head of a highly respectable but comparatively small establishment at Sandbach. He has, it will be seen, fairly beaten so far, the most eminent firms in the trade. Messrs. Fowler, Aveling and Porter, Burrell, and Marshall, can none of them equal him in economy. Messrs. McLaren are much better known in this trade than Mr. Foden, but their firm, too, is comparatively young. Yet their performance runs that of Mr. Foden very close indeed. Thus we have two new men, so to speak, beating the old hands—the very thing that it was foretold long since, by members of Council of the Royal Agricultural Society would occur if competitive trials were permitted. Of course, all that we say applies to one qualification only, namely, fuel consumption. It is nearly certain that the matter cannot end here; what we may term a return match must be played. The question is, where? In making known the award of the judges, the secretary of the Royal Manchester and Liverpool and North Lancashire Agricultural Society, stated that as the Royal Agricultural Society's Show was to be held next year at Preston, his Society could amalgamate with it for the time, and would be glad to lend every possible assistance in getting up thorough and exhaustive trials. We earnestly hope that the Council of the leading Agricultural Society will be wise in time, and take the advice offered to them. The Stockport trials cannot be regarded as in any sense conclusive. They were in no way exhaustive. They were highly interesting and instructive as far as they went, but they did not go far enough. As they stand the results may convey false impressions, or they may not. That remains to be seen. Nothing, however, can, we think, be more unlikely than that the great traction engine building firms will be satisfied to leave Mr. Foden's triumph undisputed. The sooner the Royal Agricultural Society makes known its intentions now the better. The time remaining between this and next July is by no means unnecessarily great for the construction of such a traction engine as will carry away the prize in a great all-round competition.

MAJOR ROSS ON RAILWAY BRAKES.

THE Manchester, Sheffield, and Lincolnshire Railway Company is, we understand, threatened with a test action, intended to decide whether it can, or cannot, be made liable to pay compensation to the relatives of those killed in the Penistone accident. The ground of the action will be that the company had not provided all the necessary appliances for safety, inasmuch as the brake with which the train was fitted was non-automatic, and did not comply with the Board of Trade requirements. There has been an almost universal chorus of complaint in the columns of the press; and no one has been found to say that if the brake had been automatic the slaughter would have been undiminished. The directors of the company have taken alarm. They find themselves at last within measurable distance of the time when automatic brakes must be fitted to all trains, and Major Edward Ross, the company's secretary, has, by the authority of his directors, written to the railway department of the Board of Trade one of the most injudicious letters ever penned. Mr. Chamberlain is, we believe, absent at present, and Major Ross has received no reply. His letter has been published, and we cannot suffer it to pass without some comment. Major Ross takes for his text Major Marindin's report of the 27th of July on the Penistone, or as Major Ross pleases to call it the Bullhouse accident, and goes on to say, "The inspecting officer is, as the evidence demonstrated, satisfied that the accident 'caused by the breaking of the crank axle of the engine was one which could not have been foreseen or prevented,' and that 'there is not the smallest fault to be found with the manner in which the servants of the company performed their duties both before and after the accident.' Nevertheless blame is cast upon the company for the non-adoption of a particular form of automatic brake, presumably the Westinghouse brake, which appears to be considered as the 'Board of Trade brake,' a late inspecting officer of the Board being the chairman of the English Westinghouse Company." There is, it will be seen, no logic in the latter part of this statement. No attempt is made to say by whom the Westinghouse brake is "considered as the Board of Trade brake." The reason given, namely, that Sir Henry Tyler was once a Board of Trade inspector, finds its analogy in the story that Tenterden Steeple was the cause of the Goodwin Sands. Put into plain English, the argument is—Sir Henry Tyler has left the Board of Trade, consequently the Westinghouse brake is a Board of Trade brake. To us, and we fancy to not a few of our readers, this will read like pure nonsense. In the next paragraph of his letter, Major Ross refers to Colonel Yolland's well known report on the Blackburn accident. Major Ross fails to see that this paragraph upsets the one preceding it. Sir Henry Tyler, who is not on the Board of Trade staff, approves of the Westinghouse brake, which therefore is to be regarded as the Board of Trade brake. But Colonel Yolland, who is on the Board of Trade staff, has condemned it. The natural deduction is that it is not a Board of Trade brake. This seems to us to be the only legitimate conclusion that can be reached by the method of reasoning adopted by Major Ross. Of course, we need hardly say that really the officers of the Board of Trade have no interest in any brake. All that they demand is that trains should be fitted with a proper brake. If the Westinghouse brake complies with their conditions, and other brakes do not, so much the worse for the other brakes.

It is somewhat late in the present day to quote Colonel Yolland's antiquated condemnation of the Westinghouse brake, which probably at this moment stands alone. We may say that years have elapsed since a word has been heard against the Westinghouse brake, save from two men—Sir Edward Watkin, who is afraid that it may blow up, and Mr. Moon, who has—for the third or fourth time—at last found a perfect brake. The direct and conclusive answer to Colonel Yolland's contention is that the failures of the Westinghouse brake are not dangerous failures, and that the failures of the vacuum and chain brakes are always dangerous failures. This is a point which any reader can decide for himself, whether he is or is not well versed in brake lore. Let us take the case of two trains approaching a terminal station; one is fitted with the vacuum, the other with the Westinghouse brake. Both these brakes fail in the same way outside the station, namely, by the fracture of a hose. The result is that the Westinghouse train, being there and then stopped, cannot get into the station, while the other not only gets into it, but runs against the stop-blocks at the end of the bay. It is quite true that trains have often been detained because the Westinghouse brake was not in order, and we can fancy nothing more annoying than such delays to those whose duty it is to keep the brake in order. The truth is that the Westinghouse brake spares no one; if it has been neglected by anyone, from the locomotive superintendent down to the porter who couples an engine on to a train, it will speak of its neglect at once; and the railway directors who object to this automatic vigilance ought, if they were consistent, refuse to use a workman's clock or a tell-tale of any kind. So far as is known, no serious accident has ever occurred only because a Westinghouse brake has gone on when it should not; and it is to be borne in mind that if such an accident had occurred, it would not be hushed up. On the other hand, there is no other brake in use in the kingdom which has not failed, with disastrous results, over and over again. Some capital has been made of the fact that if the cocks on the carriages are not opened when a train is made up, the driver may not be able to use it, and on a few occasions this thing has happened. This is the only defect of which the brake does not give notice of, and it can invariably be guarded against by the guard putting the brake on from his van before the train starts. A preliminary test can always be made, and once made, nothing can happen that the driver will not be told about by the brake itself. But no matter how many preliminary tests are made with the vacuum brake, security against unforeseen casualties is not provided. Even if it were otherwise, the good done by the cocks in one such case as that at Lynn would compensate for the infinitesimal risk which their use entails on properly managed lines.

Major Ross is unable to cite a single case against the Westinghouse brake. All that he can find to say "is the liability of the automatic brake to apply itself when not required, and which might conceivably cause an accident as disastrous as Bullhouse, still exists; and after the opinion as to the defects of the brake by so experienced an officer as Colonel Yolland, it seems scarcely reasonable that its use should be sought to be enforced upon the railway companies at every possible opportunity."

No one for a moment supposes that an accident might not occur because a train stopped suddenly where it ought not. Not only is this within the bounds of possibility, but it has actually happened in the United States. But it could not happen on a properly managed railway, and Major Ross dare not attempt to argue that it could occur on the Manchester, Sheffield, and Lincolnshire Railway, because to do so would be to condemn the signal arrangements and traffic management of the line. It would have been to the purpose if Major Ross had supplied a list of disastrous failures of this kind, but he is entirely unable to name one. Nothing of the kind could occur unless the block system broke down; and it most likely could not happen even then if all trains had adequate brake power. We may use Major Ross's own words with some effect in this connection. Commenting on a portion of Major Marindin's report, he says: "It is difficult to understand why he should go out of his way—except it be to create a prejudice unfavourable to the company—to use arguments which, however ingenious, may, from their purely hypothetical character, be altogether fallacious." We may say that it is difficult to understand why Major Ross should go out of his way—except it be to create a prejudice unfavourable to the Westinghouse brake—to use arguments which, however ingenious, may, from their purely hypothetical character, be altogether fallacious. The latter portion of Mr. Ross's letter being simply insulting to the Railway Department of the Board of Trade, we do not feel disposed to reproduce it in our columns, or to comment on it in any way. Mr. Chamberlain will no doubt know how to deal with it.

We may ask here why it is that certain English railway companies have fought so hard against the adoption of the Westinghouse brake, while others have freely adopted it. It was in every way desirable that at the outset careful experiments should be made with all possible mechanical combinations which promised well. These trials have been made long since, and it is now perfectly understood all round among railway men that it is impossible to produce a better brake than the Westinghouse brake, on any system yet made public. We do not say that it is not possible to invent a better brake, but we do assert that no better brake has yet been invented. If we go to the hard logic of facts, moreover, it will be found that, tested by any standard with which the lives of passengers are concerned, there is no other brake in existence which is so good. That public opinion is beginning to assert itself is, we think, certain. An event such as that at Lynn, recorded in our pages last week, may be repeated at any moment; so, alas! may be the experience of Penistone. Two such events would now settle the brake question once for all; and future boards of directors will no doubt look on Major Ross's letter with as much wonder and amusement as though they perused the old arguments that a train could not by possibility exceed a speed of ten or twelve miles an hour.

CAST IRON GIRDERS AND COL. YOLLAND'S REPORTS.

OFFICIAL reports are seldom as amusing as they might be, and we should not withhold from Col. Yolland all the credit that may be due to him for the removal of this imperfection. Last week we referred to the report by him, from which it was to be inferred that trains ought, by Board of Trade mandate, to consist of one engine and one carriage, as they would be safer than those made up of any other number of vehicles. He gave it as an axiom that "the fewer the number of engines and carriages that are used to make up a train, the less will be the risk to the public travelling in these trains." It is very well known that definitions and axioms are difficult things to write, and had the above been the production of an ordinary author, it would have been a subject for speculation whether one or two nights of anxious thought had been necessary to evolve a law of such general application. The accident which gave rise to the discovery of this law by Col. Yolland occurred to a train hauled by two engines. That the accident did not result from the use of more than one engine is a fact which did not concern Col. Yolland. There were two engines, and an accident happened, and therefore clearly there should be only one engine. A side rod of one of the engines broke. If there had been only one engine, there would have been two side-rods less, and both these might, including the one that broke, have been on the engine that would have been, under the new law, somewhere else, which is sufficient proof that the train would have been safer with the minimum number of engines. It is not proper to enquire where the engine with the defective side-rod would have been under other circumstances, as it might have been hauling one of Col. Yolland's one-carriage trains, and in that case the breakage would have been rather bad for the one engine and one carriage axiom, an extension of which will require engines to be made with one wheel, because tires sometimes break, without crank axles because these break, and with only one side rod because these break. A further but obvious extension of the new law will show the necessity for doing with but one rail, and in fact the beautiful simplicity which must result from an appreciative and judicious application of this law is as remarkable as its economy and the curious fact is that it has not been discovered earlier. Another report by the same author is worthy of the attention of a more numerous branch of the profession of engineering. It relates to the failure of some rather faultily designed cast iron girders of an over-bridge on the London and Brighton line at Denmark-hill. In concluding his report on this failure, Col. Yolland says:—"I think the prohibition which the Board of Trade has already issued against the use of cast iron beam under-bridges on railways should now be extended to the use of the same material in the construction of beam bridges for carrying roads over railways, rather than to wait for some very serious accident occurring before issuing such prohibition. It is perfectly well known that cast iron cannot be relied on, and that beam bridges constructed of this material may give way at any moment, without any previous indication or warning being given." The fact that there are thousands of such girders in satisfactory use; that those which in this case broke did so under conditions of a peculiar character; that their strength was proved by experiment subsequently to be three times the load they had to carry; that those which have been carrying since 1866 the road traffic are perfectly sound, while those which broke only carried a footpath; that enormous and ambiguous stresses have been set up by the Denmark-hill subsidences which broke a number of the girders in another part of this same tunnel bridge; these things were known to Col. Yolland, but they have not prevented his writing the above-quoted general condemnation of cast iron. Locomotive cylinders have been known to crack. Will Col. Yolland advise the Board of Trade that these should in future be made of wrought iron?

LITERATURE.

Applied Mechanics. An Elementary General Introduction to the Theory of Structures and Machines. By JAMES H. COTTERILL, F.R.S., Professor of Applied Mechanics in the Royal Naval College, Greenwich. Macmillan and Co. 1884.

IT is seldom that the conscientious and impartial reviewer of technical works finds himself in the pleasant position of being able to say with a perfectly undisturbed and happy conscience, "This is throughout and in every way a most excellent book." If he is determined to make his criticism wholly favourable and to refrain absolutely from any fault-finding, he has to consider within himself how difficult it is to produce a technical work altogether free from flaw and error; to speculate how many hundreds of mistakes he himself—the critic—would probably commit if he undertook to produce a similar book; and thereon to determine that it is his duty to be extremely generous in omitting mention of numerous little, and perhaps even big, faults that may be easily detectable by the practised eye, but are not glaring enough to be noticed by the young student or by the "uninstructed public." Without any such hesitation or qualms of conscience, we think we may pronounce Professor Cotterill's new book "On Applied Mechanics" as worthy of the most unqualified praise. It seems to us wholly satisfactory; there are no faults to be found in it except mere misprints. These cannot be counted of the essence of the work; they may, and, we hope, will, be rectified in a future edition, and in the meantime any intelligent student can correct them for himself. We trust the book will at once take its place in the colleges where engineering is taught. Its author has had long experience in teaching students devoted to a practical engineering career, and he has evidently learnt to understand very thoroughly the special needs of modern engineering students. We will say that so far as it goes, and in its special branch—which is a wide one—the teacher of engineering will find no better text-book in our existing literature of mechanics. Besides teaching experience, the author possesses great geometrical and general mathematical ability and originality. In many of his constructions for the purposes of proof, of explanation, or of practical calculation, he displays simplicity and elegance of a high standing, and his algebraic methods are equally neat and clear. Moreover, he is familiar with the most modern developments of the application of theory to engineering problems, not only in our own language, but also in French and German. For instance, in the subjects of stress and strain, he acknowledges his indebtedness to Grashof, and his book proves him to be well acquainted with the contents of Grashof's "Festigkeitslehre," than which no more thorough and succinct treatment of the subject exists, and with the work of De Saint Venant. With such qualifications Professor Cotterill ought to produce a thoroughly good and useful book, and he has done it.

The book takes for granted, on the part of the reader, a knowledge of the elementary physical laws of mechanics. These the engineering student does, or ought to, learn from his professor of physics. If any unfortunate professor of engineering finds it necessary to spend a portion of his time in explaining the fundamentals of theoretical mechanics, he must always do so under protest, and with the knowledge that he is wasting time in what is not his legitimate work. Accordingly, we find that at the very beginning of the book the calculation of the forces throughout "frame structures," *i.e.*, chiefly roofs, bridges, and cranes, is attacked. This could not form a logical beginning to the subject of "mechanics," but it is the part of "applied mechanics" that can be most easily and simply handled. Here we have the now well-known graphic construction of stress diagrams explained, and the algebraic methods of dealing with the same problems are also stated and illustrated. The next three chapters are occupied with the calculation of the compound stresses, or "straining actions," in beams and other structures. Diagrams of loads, of shearing forces, and of moments are drawn out. The remarkable and extremely useful analytical relation connecting this series of curves is carefully explained. This connection is carried upwards in exactly the same form to the higher series of curves of angular deflection and linear deflection, the development of this higher series being, however, reserved for later chapters. A very useful section is devoted to the stress due to the weight of the structure, and to comparison between the weights of similarly built, equally loaded, and equally strong structures of large and small sizes. The explanation of this last very important comparison is hardly put in so simple and useful a form as it might be. Also we find here sensible and cautious remarks about redundant structures. We need hardly say that no attempt is made to split up such structures into a series of "constituent frames," after the airy fashion employed by some very imaginative would-be teachers of engineering. The possible limits alone of the stress in each bar are made the subject of calculation.

In the second part of the book, the mechanism, or as it is styled, the "Kinematics of Machines" is treated. This title is borrowed from Reuleaux, and Reuleaux's treatment is to a great extent followed. The new phrases, "centroids," "axoids," "slider crank chain," &c., which have been introduced by Professor Kennedy, in translating Reuleaux's work, have been adhered to here; but we think decided wisdom is shown in omitting all mention of Reuleaux's semi-algebraic letter-symbolism for mechanisms, which is really useless, because a skeleton sketch is as easy to make, and is much more graphic in its description of the thing to be represented. In this part the kinematics of the ordinary straight guide-bar steam-engine is thoroughly expounded, and "parallel motions" are also explained. Use is made of a very neat and ingenious "velocity diagram in link-work," which we do not remember to have seen before. Its most general form is explained on page 123.

Part III. deals with the "dynamics of machines." We may take paragraph 94 as containing the author's definition of a machine. "A mechanism becomes a machine if we connect together two of its elements by a link capable of changing its form and so moving the mechanism, notwithstanding a resistance applied by a similar link connecting two other elements." Thus a complete machine has two more links than the corresponding mechanism, which two links are of a pliable nature, either elastic or plastic. The simplest possible mechanism has four links, or one more than the simplest possible frame, viz., the triangle. The simplest possible machine has, therefore, six links. In this view a steam engine in itself is not a complete machine; it possesses in itself one of the pliable links, namely, the steam, which is elastic; but in order to complete the machine we must connect the engine with its work. For instance, if it is driving a lathe, we must consider the lathe and the "work" in it as part of the complete machine. The "work" that is being turned, which is having "its form changed" and is resisting that change of form, is the other pliable link. The steam is the driving link and is, in this case, elastic; the "work" in the lathe is the driven link, and is, in this case, plastic. The complete idea of a mechanism was first definitely explained by Reuleaux. This complete idea of a machine is due to Professor Fleming Jenkin, and is not quite satisfactory.

In Chapter IX. curves of driving moment or "crank effort" for engines are drawn, and use of them is made to calculate the "fluctuation of energy" and "fluctuation of speed." This, of course, can only be done when the curve of "resistant moment" is also given. The fluctuation of energy is easy to reckon. That of velocity is more difficult, and the method here given is not exact; it is slightly vitiated by the assumption that the arithmetic mean between the least and greatest velocities is the true mean or average velocity. This is by no means true, the error being greater the larger is the whole variation of velocity.

The effect on the distribution of crank effort of the inertia of the parts moving with variable velocity is carefully considered, and the common methods of balancing explained. Here, however, the author adheres to the common practice of taking account of only one component of the acceleration of momentum, namely, that component parallel to the engine stroke. The transverse component of the acceleration of momentum of connecting rod and crank pin are really quite considerable, and if a balance weight is introduced to balance the longitudinal component, this balance-weight—if, as is always the case in practice, it revolves with the shaft—itself introduces a large transverse component, which remains unbalanced. On page 275, line 6, we notice a slip in which the word "divided" is used instead of "multiplied," a very awkward inversion, because it refers to a question in which all elementary students get confused. At the top of page 292 another misprint of importance occurs, where the couple is written of only half its true magnitude. We wish these chapters had treated governors and dynamometers somewhat more fully.

Part IV. deals with "stiffness and strength" in a very thorough way. The ordinary theories of bending and torsion are explained in a very elegant and simple style. and due prominence is given to the important fact that the shear force in beams is not evenly distributed over the section, so that the stress at the neutral axis is in solid rectangular sections one and a-half, and in solid circular sections one and a-third, times the average stress. With a rough degree of approximation, the whole shear force may be considered evenly distributed over the web section of an I girder. The method of solving the problem of a beam propped in the middle is peculiarly simple—page 330—as is also the deduction of Clayperon's theorem of three moments—page 336. We are sorry to find no attempt to attack the problem of beams bent beyond the limit of elasticity of the material.

Chapter XIV., on the strength of struts, is a great dea more satisfactory than the ordinary slipshod treatment this subject receives. Here it is plainly shown that no even approximately accurate calculation of the strength of a strut can be made without a knowledge of the deviation of the line of thrust from centre of figure of the end section. The bending, and consequently the strength, of the strut depends wholly on the exact magnitude of this deviation. In the ordinary case the deviation is intended to be zero, and therefore may be presumed to be small; but not even the wildest guess at the strength of the strut can be made by calculating on the supposition that it is actually zero. The ordinary text-book theory worked out on the assumption that it is zero gives the humorous result that the load which will produce no deflection is something between five and fifty times the load that, it is well known, will break the strut; but this result is reproduced in succeeding text-books with the utmost gravity, and apparently with no appreciation of the grotesque humour involved in its statement as a fact. We have here, however, an acknowledgment that it is not true even as a piece of mathematics; and this is a great step in advance. The author very ingeniously avoids the peculiar difficulties of the problem by assuming a strut with such a variation of section as will produce uniform bending in a true circular arc. A result of the desired form is in this way arrived at with the help of the very easiest mathematics; but it must be remarked that such a strut was never made, and that the necessary variation of section to secure this result has never even been calculated.

Then comes a chapter in which "Impact" is treated in a skilful and simple manner, which shows strikingly the great importance to engineers of careful study of this subject. We might object that no structures of any kind are actually borne on "immovable supports," and that their mobility, and the special dimensions and form of the structure resting on them, make great differences in the stress-effects of blows; but the equations given are, at any rate, sufficient to illustrate in a forcible manner the interest and importance of the subject. The most general fundamental equations of elasticity, and the behaviour of plastic solids, are then explained, as well as the influence of repetition of stress. Part V. deals with hydraulics and hydraulic machinery. Of course, the information regarding the machinery does not extend to the details of construction, but the mechanical principles expounded in this section embody the most modern ideas on the subject. More rapid advance is being now made in this division of mechanical science than in any other, and it behoves engineering students to keep themselves abreast of the times. To the problem of the action of turbines, the equations of "angular momentum" are successfully applied. We wish the subject had been treated in a more complete manner. Interesting equations are given for the "fluid efficiency" of the propulsion of ships. If V be the forward velocity of the ship, and v the relative backward discharge velocity of the stream of water, the driving back of which furnishes the necessary abutment for the forward propulsion of the ship, the efficiency is given as $\frac{2V}{v+V}$, the waste energy being the kinetic energy of the back flowing stream. As v is not at the outset a known quantity, this is hardly the most convenient form to throw the fraction. It may also be expressed in terms of A, the cross section of the back flowing stream. If R be the resistance to the forward motion of the ship, the above efficiency may be found to be—

$$\frac{4}{3+\sqrt{1+2\frac{R}{AV^2}}}$$

This may be thrown into this other form. If we write—

$$R = k L^{\alpha} S^{\beta} V^{2+\gamma}$$

where $k\,\alpha\,\beta\,\gamma$ are constants, L the length, and S the mid-ship section of the ship; and furthermore if we write—

$$S = m L^2$$
$$\text{and } A = q S,$$

we have the efficiency in the form—

$$\frac{4}{3+\sqrt{1+\frac{2k}{q m^{1-\beta}} L^{\alpha+2\beta-2} V^{\gamma}}}$$

If, as is usually taken, $\alpha = \beta = \frac{2}{3}$ and $\gamma = 0$, then this fluid efficiency would be the same for all speeds and the same for all ships which have equal values for $k\,m$ and q. These equations assume that the water is thrown backwards without any lateral or rotational velocity, the production of which, of course, further diminishes the fluid efficiency. The last chapter of this interesting book is entitled, Pneumatics and Thermodynamics, and is for the most part a *résumé* of what can be found in the author's well-known work on the steam engine.

We conclude by once more heartily congratulating the author and the publishers on the production of a high-class work, which we hope will become a standard text-book in engineering colleges.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—G. Watson, chief engineer, to the Northumberland; W. R. Parker, assistant engineer, to the Canada; and C. E. Shorey, assistant engineer, to the Agincourt.

WOOD'S STRING SHEAF-BINDING REAPING MACHINE.

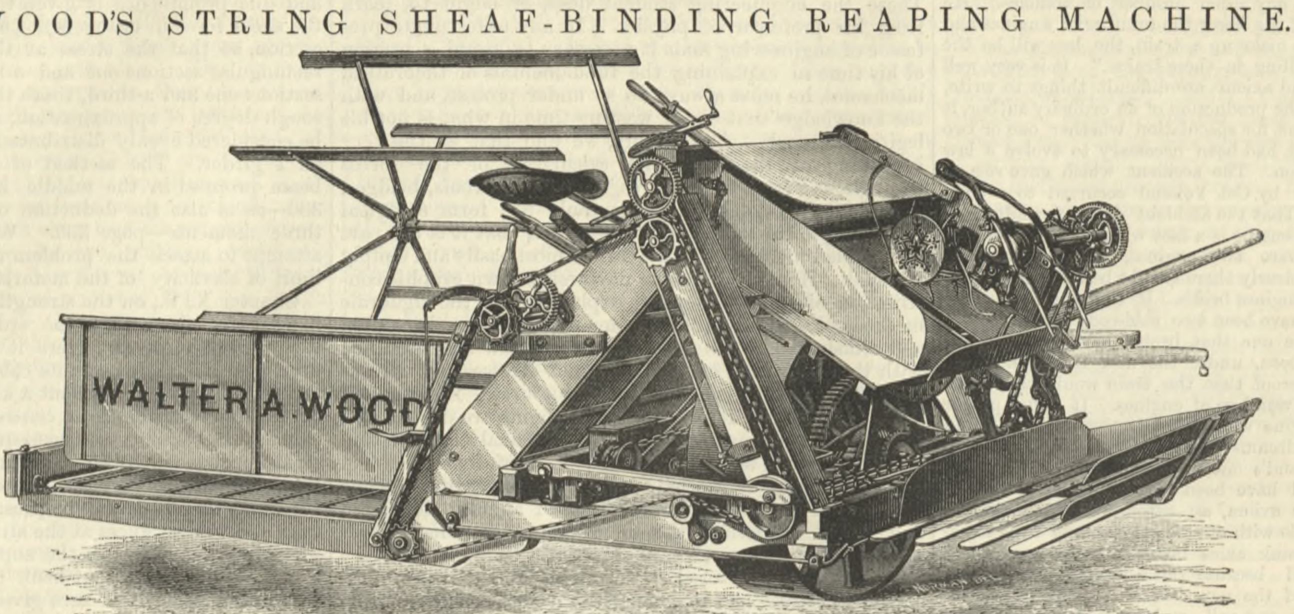


Fig.

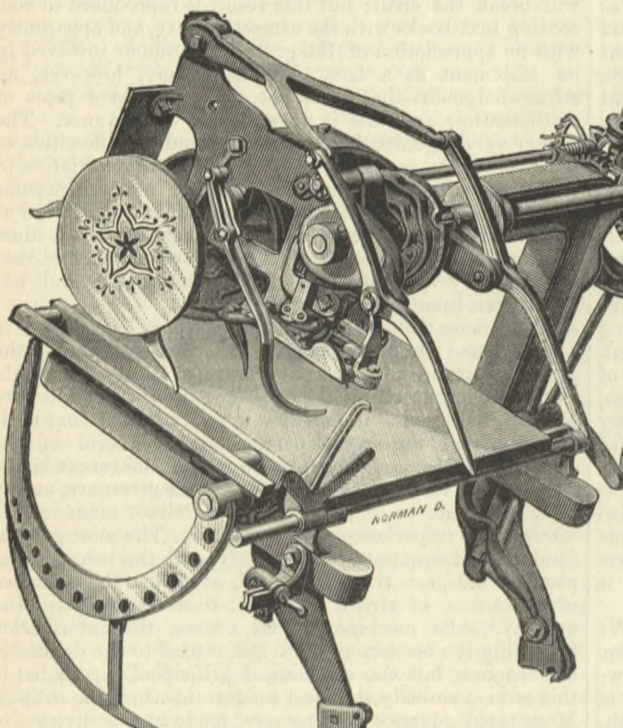


Fig. 2

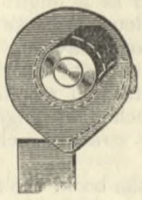


Fig. 8

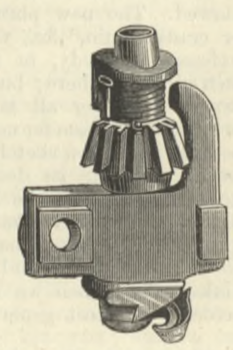


Fig. 7

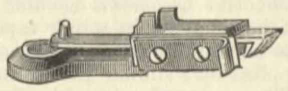


Fig. 9

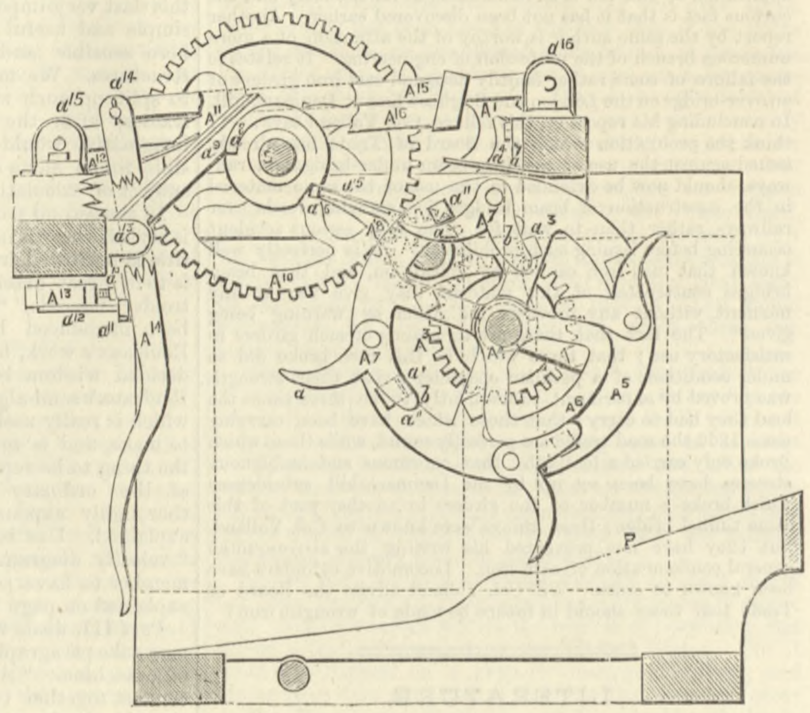


Fig. 10

SHEAF-BINDING REAPING MACHINES.

No. V.

Although Wood's sheaf-binding reaping machine did not achieve that success at Montford which its great popularity in America and elsewhere led many to expect, it is nevertheless one of the most noteworthy examples of the 1884 machine. It is in essential matters distinct from all the others, and its continued commercial success must be chiefly ascribed to its practical efficiency. For several reasons the machines which may be all that is desired on

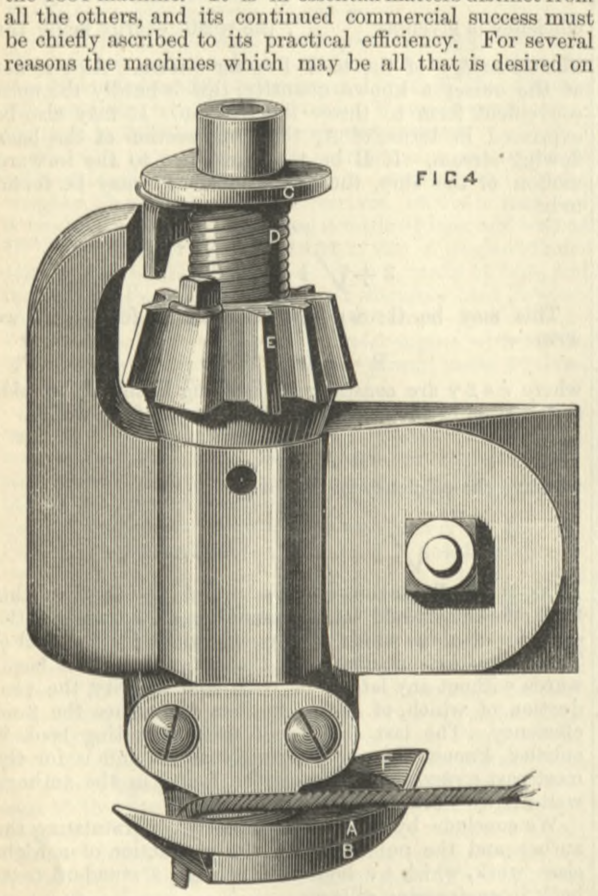


FIG 4

the light open crops of America and some other countries, do not generally remain the favourites in Great Britain. The fact is not wholly due to the greater patience of Americans in manipulating machines, though it is partly, no doubt, due to this, but the English machines seem to owe much of their success to stiffness and rigid strength, as well as to that compliance with the numerous circumstances which the remarkably miscellaneous character and conditions of our crops demand. Generally, however, the Woods machine is very successful in doing good work under the every-day conditions imposed upon it by the exigencies of ordinary farming; and even if this were not a capital recommendation, it has the merit from the point of view of a mechanician that it is as already stated distinctly different in essential particulars from the other machines which have gained notoriety for good work. It is different in its packing mechanism, in its knotting device, in its trips, and in the arrangement of the binding apparatus generally, the whole of which is above the binding platform. In all

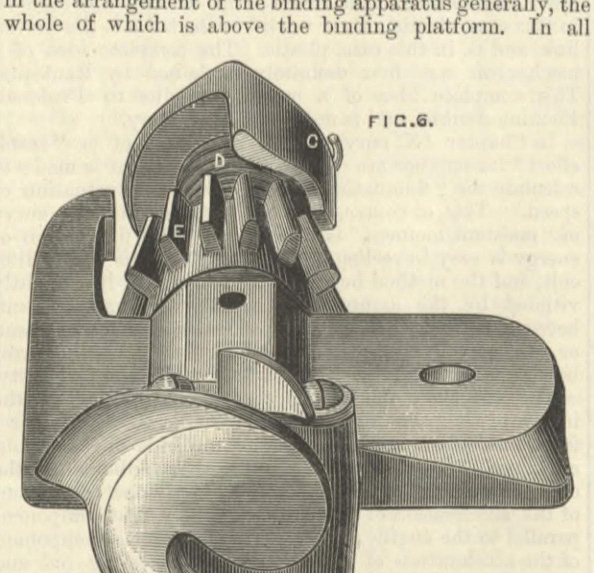


FIG.6.

essential features in design and in its mechanism, this machine was so fully described in The Engineer of the 26th August, 1881, that we have now only to refer to those parts of the machine as exhibited at Shrewsbury and tried at Montford, which have been much modified since 1881.

In Fig. 1 is given a general view of the Wood machine showing principally the off and rear sides. In Fig. 2 is a separate view to an enlarged scale of the binding mechanism. In Figs. 3 to 9 are given views of the knotting device, showing different positions in several stages of the formation of the knot and of the cutting and gripping device. Reproduced from our impression of the 26th August, 1881, is a view, Fig. 10, showing the packers, which although now somewhat modified, are there shown in principle.

In Fig. 10 *p* is the binding platform, and the packers are shown above it. The pieces A 7 carried on the wheel A 5 rotating in the direction shown by the arrow, are loose on their pivots, except when passing the fixed cam A 6.

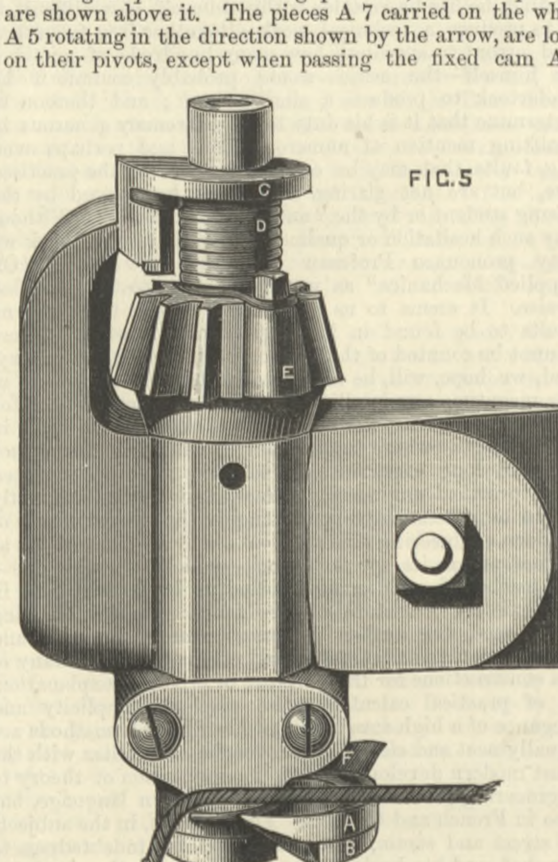


FIG.5

During the latter part of the revolution of A 5 the packers A 7 are stiff, and pack the corn against the arm A 14. The latter is now modified as seen in Fig. 2, and beside the lever which takes the place of A 12, is the trip lever curved at its lower end—see Fig. 2—which presses upon the sheaf, and is by the latter, when fully made, lifted upward and caused to set the knotter into gear. It will be seen from ig. 10 that the packer arm, which has upon it the mark A 7, has passed the cam or quadrant A 6, and is loose upon its pivot, and cannot, therefore, exercise any power upon the corn; that packer, however, which is still immediately below the mark A 6 is stiff as against any pressure in front of it, and will continue to be so until in its path it has passed the quadrant A 6. When the sheaf has reached the predetermined size, the trip arm above it, seen in Fig. 2, releases a trip and puts the cam cog wheel at the end of the main cam, into operation, and the knotting mechanism is thereby started; and the ejector arms—see Fig. 2—are caused by the same means to rise, pass behind the sheaf, and finally to push the sheaf off the machine in returning to the position shown in Fig 2.

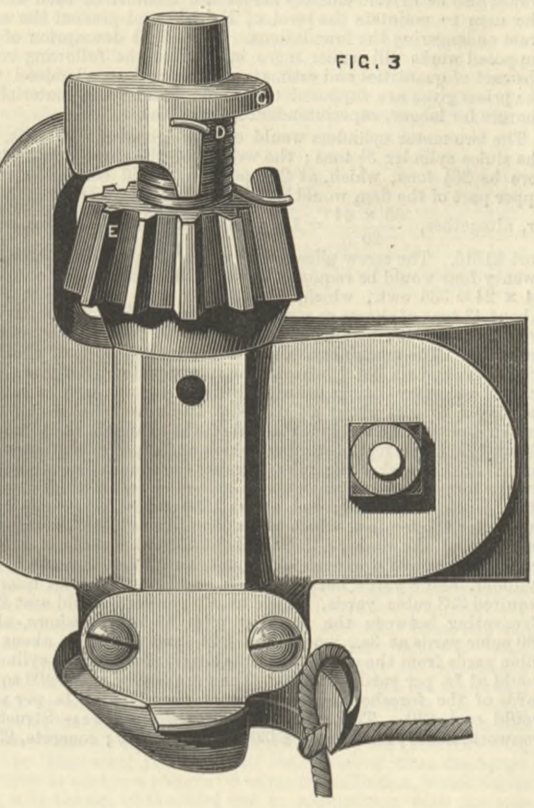
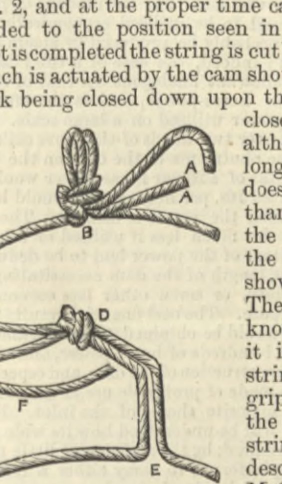


FIG. 3

Turning now to the knotter, it will be seen that the part shown in Figs. 3, 4, 5, 6, and 7 is seen in Fig. 2 in its place. The binding hook is in two parts A and B; these have, during part of their rotation, a relative movement, the lower part B being fixed to an inner spindle actuated by the piece C and the spiral spring D, while the part A is on the hollow spindle, which carries the pinion E seen in each of the figures. In Fig. 5 the string is seen resting upon the horizontal part of a piece shown in all these figures fastened by two screws. By the motion given to the pinion E from the cam with quadrant seen in Fig. 2, the hook moves into the position shown in Fig. 4. By the continued rotation of the hook, the string is caught and carried by part F standing up from the upper part A of the hook, and is by this means wrapped round it until the lower part of the string slips partly over the rounded bottom of the hook, seen in Fig. 6. The hook, however, continues to revolve until the part C catches against the projecting horn, and when this takes place the lower part of the hook is fixed, but this upper part can still turn a little further against the resistance of the spiral spring shown; the result is that the mouth opens and lets the lower part of the string into it. At this moment the return motion occurs, the loop is pushed off the hook by the piece held on by two round-headed screws, the expansion of the sheaf pulls the string tight and out of the hook mouth, and the knot is complete. From the little plan, Fig. 8, the stop on the top of the hook spindle will be better seen. By this time the knot in the form seen in Fig. 11 has been made, as somewhat imperfectly shown in Fig. 3, and the string, as in other machines, is at one end held by the gripper, seen in Fig. 2, and in detail at Fig. 9; while the other end is carried by the semicircular binding arm seen below Fig. 2, and at the proper time carried round the sheaf and guided to the position seen in Figs. 3 to 6. When the knot is completed the string is cut by the device seen in Fig. 9, which is actuated by the cam shown in Fig. 2. The knotting hook being closed down upon the sheave, the knot is tied close up to the sheave; and although the ends are rather long, as shown at Fig. 11, it does not take any more string than the Appleby knotter, as the latter cuts off and drops the short piece F of string shown detached in Fig. 12. The form of the completed knot is seen at Fig. 11, and it is remarkable that if the string is dropped from the gripper seen in Fig. 9, that the apparatus picks up the string again automatically as described with reference to McCormick's machine, and it, moreover, is not prevented from proper action if straw gets tied up with the string. As soon as the knot is completed, the string is severed at A A by the cutter, which is combined with the gripper, and which is actuated by the cam at the inner end of the large cam spindle. The knot is, as shown, tied closer to the sheave than is possible with the Appleby knotter. The packers on this machine are thrown out of gear by the action which throws the knotter into gear, so that as soon as the proper size of sheaf is reached the packing is discontinued until the tying is completed.



Figs. 11 & 12.

LETTERS TO THE EDITOR.

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

WATER-TUBE BOILERS.

SIR,—In my previous letter I so far touched on two of the main questions raised in the discussion of this matter, viz., how much cheaper and how much safer are water-tube boilers than those of the Lancashire, Cornish, or locomotive kinds? I shall now endeavour, so far as space will permit, to deal with the remaining point, viz., how much more economical? In doing so I shall confine my attention to Cornish and Lancashire boilers, leaving out of view locomotive and other good multitubular types, chiefly because it would involve too much writing to bring these out in proper relief to the other two forms with which they are sometimes undeservedly associated.

Before, however, proceeding with the point of economy, pardon me if I allude to the editorial foot-note to a correspondent's letter in your issue of Friday last. Galloway tubes are by it recommended to promote the more rapid heating of water in the underside of the boiler, and this is a recommendation often given, and often followed at great cost. In fact, the circulation by means of Galloway tubes of water from the under to the upper side of the furnace flue in Cornish and Lancashire boilers is one of the grand strings on which their sale and application have been persistently harped ever since their introduction. Many have questioned from the first whether such circulation has any existence. In fact, if it does exist, the Cornish and Lancashire boilers cannot in such case possibly be the irredeemably bad and terribly dangerous structures some think them, and as I have, humbly but honestly, endeavoured to make them in my two preceding letters. If such circulation exists, it is surely the least thing the advocates and sellers of these tubes can do—after pocketing their princely fortunes—to set forth, in the opportunity presently afforded by you in this correspondence—for which much thanks is due—the grounds or theory on which such circulation is based, or to point out the ways and means by which its truth may be demonstrated. For my part, I have in many ways proved and demonstrated—and will again do so to the satisfaction of any one open to conviction—that there is not the slightest semblance of the circulation claimed; that the water in a boiler behaves exactly in Galloway tubes as it does outside of them, exactly in a boiler with as without them. But I do not ask or wish either steam users, Lancashire boiler makers, or Galloway tube sellers, to take my word on this or any point unless I can adduce good and conclusive reasons in support of it; and, on the other hand, I will not have their assertion of Galloway tube water circulation on any other footing. Already my letters indicate that the circulation of water in a Cornish or Lancashire boiler is as great an incongruity as "snow falling upwards." I now assert that circulation of water within any form of Cornish or Lancashire boilers, with or without Galloway or any other conception of tubes in general use, is as pure an illusion—or more correctly, delusion—as was that of the bursting of boilers by unknown gases or sudden generations of steam, or the blighting of crops by witches. I further assert that the large proportion of untimely frailties and explosions of Cornish and Lancashire boilers is because of temperature straining, due to the absence of the water circulation which is claimed to be promoted by Galloway tubes, and other contrivances having the same pretensions, which are foisted into use to the loss and sometimes ruin of steam users, and the no small risk of others of her Majesty's lieges, and I challenge the questioning of these assertions. This may be putting the case strongly, but it is only by so doing that superstitious views may be broken up. It was only in that way that the chaos of thought on boiler explosions was broken up—a breaking up which has been rapid, complete, and universal, thanks to Clark, Colburn, and a few others, whose keen perceptions squared their—and now our—ideas on boiler explosions with nature's laws—the voice of God, to which sooner or later kings and priests as well as boilers and tubes must yield implicit obedience.

It cannot be denied that through-and-through water circulation is obtained in small degrees from Galloway tubes in a vertical main flues, but this is exactly where circulation is in no way required for safety. Neither can it be denied that water circulation of a kind takes place in them when applied to Cornish or Lancashire boilers, but I do deny that it is of a kind which in any way affects the water at the under side of the furnace tube, or of the kind professed and so much desiderated in reduction of the dangers of the temperature straining of boilers. On the contrary, it is simply circulation of the same kind as takes place in a pendant or "Field tube," or simply the same as takes place at the vertical—or rather curvilinear—sides of the furnace flue itself, or any other vertical or inclined heating surface touched on by the passage of fire or its heated gases; the only difference between the circulation at such surfaces and that which takes place in a "Galloway," "Field," or any other vertical tube, is that the water takes the form of rectilinear vertical eddies in place of curvilinear and concentric ones, as in tubes. How can it be otherwise? Temperature and gravity are in harmony, however much we may differ, and in respect of that harmony water can only descend from its surface to a zone of temperature in its mass, which by its lower temperature forbids gravity from carrying the descent further, and that zone is fixed by the line of flame or heat which strikes the heat-transmitting surface of the boiler, irrespective of their being tube surfaces, flue surfaces, or shell surfaces. To put it in another way, water must descend at vertical plates, and in the centre of Galloway or other vertical tubes, because it is of lower temperature than the water which abuts on the heat-impinged iron sides retaining it. Whenever or wherever the iron ceases to be impinged on by the heat, or in any way becomes of a lower temperature than suffices to shoot heated molecules of water to near the centre of the body of water in the tube—or as in the case of straight surfaces, to given limited distances—with sufficient force to secure a higher temperature than that of the zone of water immediately under these lower lines of flame or heat, the descent stops till the water acquires more heat, by virtue of which it lightens and returns to the surface, and so sets up a circulation exactly comparable with that set up by directing a small jet on the surface of, say, a tank of water, as is beautifully illustrated when this is observed from the glass walls of an aquarium fish tank, the only difference in the case of it being that the descent is by force, not by unequal specific gravity, and continues till momentum is exhausted—in place of continuing change of temperature or gravity—at which point the jet is seen to curve outward from the centre and rise to the surface in a graceful shower, as the jet of a garden fountain is seen to act in the reverse way when playing in the air. Now, the circulation in a fish tank set up in the way described is as innocent of any effect on the water underlying its power of penetration as is that of the eddying circulation set up at the upper end of the Galloway tube on the water underlying the furnace flue. If I have failed to make myself clearly understood in thus describing water circulation in a Galloway tube, your readers may make up the deficiency of my language by supposing that what is meant to be described is exactly the same as is seen in the boiling of an ordinary pot of water on an ordinary fire—because the only difference between the pot and the Galloway tube, in point of water circulation, is that the pot has a metal bottom, which limits the circuit of the water; whilst the tube has a water bottom, or a zone of water lower in temperature than that in circulation, which fixes that limit. Of course, the pot receives heat at the bottom as well as the sides, and this "jumbles" the water, and destroys the regular lines of the movements of circulation, as seen when heating a tube of water similarly to the heating of a Galloway tube which takes place in a boiler. This is a process of heating and circulation may be quite successfully performed in an experimental way, even by a schoolboy. I am not, however, addressing these, but men—men whose words and dictum leads and guides the world in matters relating to steam boilers; and as schoolboy experiments are likely to meet with their sneer, and unlikely to bring positive conviction to their minds, I recommend them to make the experiment with a veritable Lancashire boiler fitted with Galloway tubes. The way to make the experiment is simply to close up the flues under the boiler—from whence comes the only, or at all events the great share of heat which is supplied to the lower water in the boiler—allowing the gases to pass direct to the chimney on leaving the furnace flue. If the water is cold at commencement of firing up, the tubes and flue clean, and the stoker puts nerve into his movements, he will have steam at 50 lb. to 70 lb., or nearing 300 deg. temperature at the upper side of the flue before the water at the under side has attained a temperature fatal to the life of a "tropical fish," as it was formerly put in these letters.

Pardon me, further, if I add a word to the advice you give to your correspondent. The addition of Galloway tubes will, as I have here endeavoured to show, make no possible difference to the heating of water at the bottom of his boiler, except that they may so far choke the passage for flame, and force it to take a somewhat lower course in the furnace flue. If the products of combustion are escaping to his chimney at more than 450 deg., Galloway tubes will in that case, by increasing the heating surface, help to reduce the gases to the point of temperature named, which ought to be quite sufficient for the purposes of good draught. If Galloway tubes are resorted to, they should be closed at their upper ends, and thereby the heat imparted to them will all be forced to the underside of the furnace flue; in this way, but not otherwise with these tubes, will a better equalisation of temperature be secured. Greater freedom from temperature straining by this device will also be secured than has yet obtained in any Cornish or Lancashire boiler in the Midland counties of England, so far as I know; and I here add if ever the Cornish and Lancashire boilers are to be made safe and reliable in tolerable degrees, their safety must be accomplished by some device of tubes whereby the higher heat of the furnace flue will be partly communicated to the under as well as the upper water. But these classes of boilers, wrong as wrong could be from the first, are only made "wronger" by every hitherto attempted improvement; and what profiteth "cleaning the windows of a house on fire?" Let your correspondent's flues also be altered, so that the first pass of flame on leaving the furnace flue will be along one side of a centre wall below the boiler, and thence along the other to the chimney, instead of having, as at present, the third pass directly under the boiler. Do not split the flues or flame on any account. The late C. Wye Williams, of Liverpool, put us right on these split flues in a little book on "Coal and Smoke Combustion" before Galloway tubes existed. That book is slightly astray on some points found out now by boiler engineers, but it is still worth "half-a-hundred score" of the little books—reports—of questionable, "wise saws and modern instances" by which this correspondent appears to have been guided.

How much more economical? If we only take into account the records and demonstrations of shows or exhibitions in considering the question as to which class of boilers are most economical in fuel, the Cornish and Lancashire would stand highest by at least 5 or 10 per cent.; but boiler shows and exhibitions, excellent as they are in their own way and place, have generally little more relation to every-day boiler uses than have laboratory or lecture-room experiments to the regular process of commercial manufacture. Of course, like Webb's swimming or Weston's walking shows, the feats at boiler shows, and also lecture shows, teach us great and valuable lessons, provided we do not witness them as strangers to the matters shown. But deep scrutiny, as well as much acquaintance with the cunning pre-arrangements, the clever dexterities, and the superior knowledge and facilities of the performers, is often required before one can see the proper relations the things shown have to things of every-day working; or, to put it in the fashion of the words you employ in your last leader on this subject, things as shown "are not true as they stand, but are so far credited by those who are unable to check them or see what is meant by the 'showmen,' that they are likely to do harm, to the extent that they prepare the way for 'boiler-selling enthusiasts' to claim much greater savings as due to real improvements, perhaps, or maybe nostrums of at least doubtful utility than is possible under 'ordinary circumstances,' though quite possible under the most favourable circumstances." "You can't come into my show without paying, but you may pay without coming in," was Artemus Ward's humorous way of putting it. Certain discontents concerned in the recent show at Calcutta, however, fail to see eye to eye in this with the renowned Kangaroo showman; for, being strangers, they were taken in with due hospitality as they imagined, and I incline to agree with them and differ from Artemus to the extent at least of thinking it possible for strangers to be taken in at a show. Nevertheless the portable engine boiler tested at Cardiff Show under the Royal Agricultural Society in 1872, whose duty is interestingly recorded in your leader, was beautiful as a work of art, as it was excellent in steaming efficiency and safe against explosion. It were serving our country much had we more like it, and fewer of the elongated tunnel-like furnace flue kinds. Economy in steam generation depends mainly, if not entirely, on two things, with which, in an abstract point of view, the kind or construction of boiler has little or nothing to do, and a locomotive, Cornish, Lancashire, water-tube, and even a plain cylindrical or egg-ended boiler may—or rather must—evaporate 11·85 lb. of water per lb. of coal as well as the portable engine boiler at Cardiff Show, whenever and wherever these two things are accomplished in equal degrees of perfection. This statement may be a "staggerer" to many if not most of your readers, but what may surprise them more is the equally true statement that there is no difficulty whatever in so securing these two things, whereby a similar evaporative duty is obtained with a plain egg-end boiler, if its furnaces and building are properly arranged and proportioned. But I fear I have again exhausted your space without having anything like exhausted the point in hand. Meanwhile, I will wait response to my challenge, and will or will not return to the subject in your pages, according to the spirit in which the views I have already expressed are received. The great artillery guns of the Cornish, Lancashire, Galloway tube service with which the country has been beseiged so many years are, as I believe, "most ignorant of what they are most assured, and play such fantastic tricks before high heaven as makes" wives and mothers, if not "the angels," weep. If they think me a foeman worthy of their steel, and would like to have the points out, I am open for an encounter, and will argue, advise, dissent, contradict, or scold as circumstances may direct.

GRAHAM STEVENSON.

Airdrie Engine Works, Airdrie, N.B.

THE NATURE OF MATTER.

SIR,—Sir William Thomson's address, delivered at Montreal and published in your pages last week, contains such an important verification of the soundness of the views which you have courteously permitted me to set forth in your correspondence columns, when all other scientific journals were closed against me, that I may perhaps be excused if I call attention to the fact. This, however, is not my only or chief object in writing now. I desire, with your permission, and as briefly as possible, to call attention to one or two matters which are, so far as I am aware, entirely neglected in the writings of men who, like Sir William Thomson, deal with mathematical and physical science. I feel a good deal of diffidence in approaching the subject, because it will be difficult to make my meaning plain in the compass of a short letter.

The point on which I wish to insist is that there is no such thing in nature as a discrete phenomenon, or an isolated form of matter or energy; and if this truth, instead of being systematically neglected, were carefully taught, there would be small repugnance felt toward the views enunciated by Sir William Thomson. What I wish to convey is, that the properties of matter vary with the conditions under which it exists, and that it must always be taken, not by itself, but with its conditions. For example, we say that iron is a solid, and mercury a fluid; but this is simply a result, not of the behaviour of the metal alone, but of the metal and its environment. Thus, let the mercury be exposed to the influence of a freezing mixture, and become solid. Let the bar of iron be placed in a furnace, and it becomes fluid. In all cases we have duality to deal with, namely, matter and the conditions under which it is presented us. To cite another example, we may take water, which is either a solid, a fluid, or a gas, according to the conditions of environment. Again, oxygen and hydrogen, in the proportions H_2O, may be kept mixed for any length of time. They still remain gases and behave as such. Let us modify the conditions of environment, by applying a light. They explode and become water. Introduce a new set of environing conditions by putting the water into a boiler and heating it, and we have steam. Change the conditions once more, pass the steam through a red-hot iron tube—presto! the steam has disappeared, and instead we have hydrogen gas and oxide of iron. Again, let us take a plate of iron, keep it dry, and it will remain unaltered; let it get wet with slightly acidulated water, and the iron will entirely disappear. In its stead we shall have a mass of red rust, oxide of iron. So we may proceed to any length we please. We always find that matter, Proteus like, assumes all manner of forms, according to the conditions of its environment, and has apparently no form indigenous to it.

Certain forms of matter are called elements only because we are unable to break them up into two or more constituents. No one, however, has yet obtained an element clear of conditions of environment; indeed, we know that we have only to change the characteristics of the element disappear. But it may be said that when the conditions are precisely similar for two elements, they present different characteristics. Thus, for instance, at normal temperatures, a lump of gold and a lump of lead may exist side by side, and cannot possibly be confounded with each other. On such a basis it is argued that there must be, at least, as many kinds of matter as there are elements. I confess that I cannot see the force of this argument, if it has any; for it must always be borne in mind that the thing reacts on the environment, just as the environment acts on it. It by no means follows, therefore, that because the conditions are apparently the same for both lead and gold, they are really so, and it is by no means impossible to conceive that a mere change in external conditions of environment would make the lead look like gold, or even the gold look like lead.

It would take up much more of your space than I dare to ask for to pursue to its end the line of argument which may be based on the purality of all the phenomena of which the human mind can take cognisance. If I have succeeded in setting any of your readers, especially students, thinking in this direction, my object will be gained now, and at a future time I may ask you to allow me to reopen the subject. Φ. Π.

London, September 8th.

DOUBLE BOGIE ENGINES.

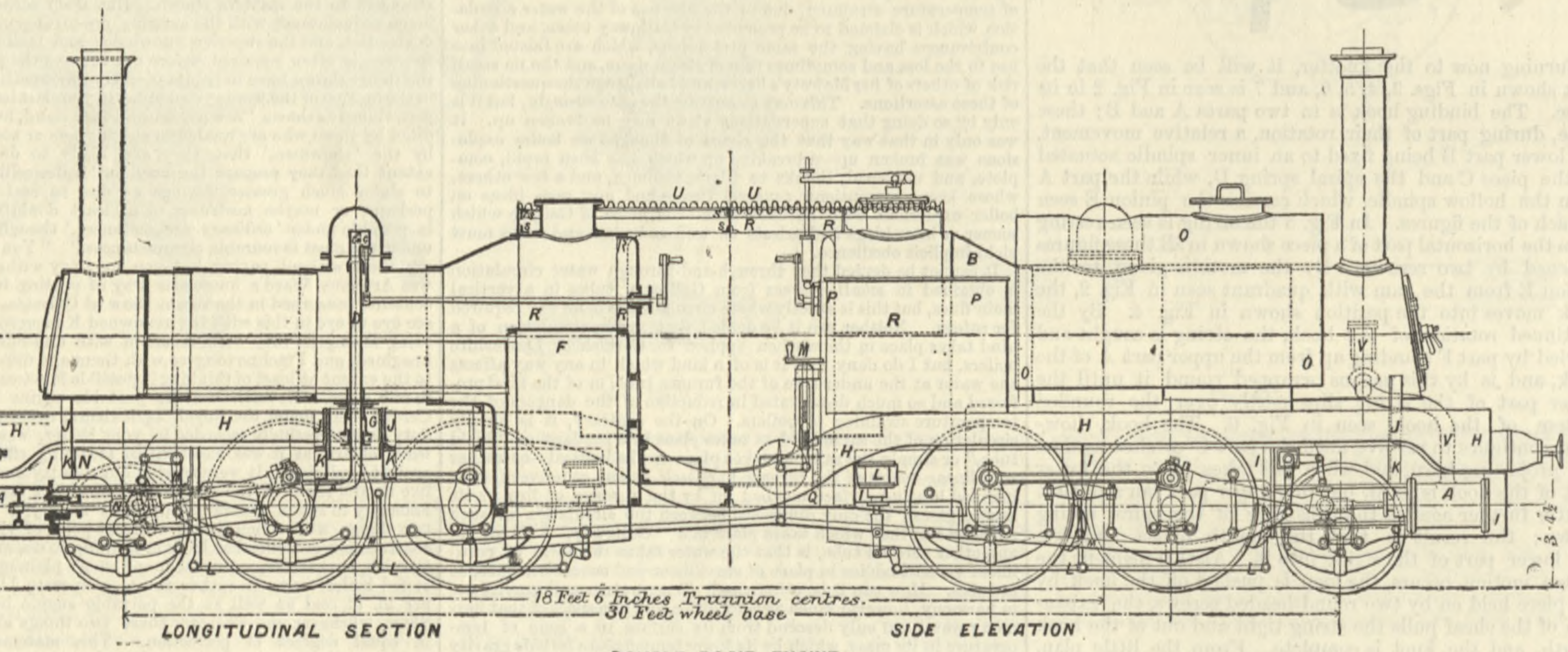
Sir,—I beg to forward you a lithograph and specification prepared by me for a double bogie locomotive to work the light country cheap lines of railway of 5ft. 3in. gauge with heavy gradients and small curves, the object being to produce a reasonably powerful engine with the least possible wheel pressure upon the rail and free to pass round small curves and with sufficient adhesion to ascend inclines of 1 in 30 in frosty weather. I am not in the Government service, therefore send it independently, and if you feel inclined to publish an outline of the engine and specification, I shall be glad, as I wish to obtain comment, adverse or otherwise. The lithograph shows 11in. diameter cylinders, but I have increased them in the specification to 11½in. to work more expansively; the wheels also from 4ft. to 4ft. 3in. diameter. If this engine can be produced to give the results anticipated, there should be a large field for it in this colony, as all the lines are 5ft. 3in. gauge, and light and cheap lines are to be constructed; the ruling gradient of the present lines is 1 in 50, and a few instances of 1 in 40, but would be increased to 1 in 30. To work these inclines engines have from 6 to 7 tons upon each coupled wheel, and then slip with four coupled wheels and train of eight carriage of 8 tons each light if full steam is given. High speeds will not be required, but speeds up to fifty miles per hour can be attained with this engine. The engine differs from the Fairlie in dividing the boiler into two, to prevent the water leaving the tubes in ascending steep inclines, also in the steam pipe having a radial action through an ordinary stuffing-box, and by placing the wheels outside the boiler, thereby increasing the diameter of the wheel, and by leaving space between the boilers with foot-plate to enable one set of hands to work the engine and obtain access through and around the engine. If any manufacturer should feel inclined to communicate with me upon the subject I shall be glad, as I hold a patent in this colony for this engine.

A A are the cylinders; B, boilers; C, regulator nozzle screwed on to steam pipe; D, steam pipes; E, steam pipe stuffing-box; F, inside copper fire-boxes; G, bogie trunnion cylinder fast in lower frame, upper frame moving around it; H, upper outer frames; I, lower or bogie frames; J, cross stays, upper frame for bearing boiler, also for draw hook; K, cross stays, bogie frame for upper frames to rest upon, faced for traverse; L, steam brake; M, reversing gear worked by vertical screw with indicating pointer and graduated quadrant plate for pointer to work against; it will probably be found that the reversing lever and rods can be better arranged below the axles, as shown in red lines; N, valve rod guide bracket; O, water tank; P, coal bunkers; Q, lower tie plates, 7in. by ⅜in.; R, side tie plates; S, stay angles attached to side tie plates and cross and longitudinal girder stays attached to crown of fire-box shell and diagonal stay angles; T, lower angles attached to longitudinal lower tie plate, back plate of fire-box and foot-plate; U, corrugated roofing; V, exhaust pipe; W, fire-door mouths; X, water spaces. Slight errors have occurred in the litho, which I have altered in red ink, the red lines being the corrections.

Whilst locomotive superintendent of the Japanese lines, 3ft. 6in. gauge, I had engines built with 11½in. cylinders, 17in. stroke, 4ft. 3in. diameter wheels, four coupled, with 3 tons 12 cwt. upon each wheel, which have hauled for ten years twenty carriages, each 6 tons light, up inclines of 1 in 100. Therefore the load was twenty carriages, each 6 tons weight, plus the passengers, which averaged fifty passengers per carriage—say, 20 × 6 tons + 2 tons each carriage = 160 tons, distance—length of Yorkshire line—18¾ miles, with five intermediate stoppages in 55 minutes. It will be seen that the double bogie engine is simply two of these engines combined, and ought to produce nearly double the result.

F. C. Christy, M. Inst. C.E.

Exchange, Melbourne, Victoria, Australia, July 9th.



DOUBLE BOGIE ENGINE.

TIDAL POWER.

Sir,—As you think that there has been too much vague writing on this subject, but undertake to publish an estimate of the cost of plant to utilise 300-horse power for ten hours per day by my system, you place before me a task of extreme difficulty; for I am not in the position of those inventors who hold a patent for, and manufacture their inventions, neither am I a practical engineer, with an extensive knowledge of the cost of the various kinds of work which would be required. If I were both of these, however, my difficulty would scarcely be less, under the circumstances; for the most experienced engineer would not like to hazard an estimate of the cost of, say, docks of a certain area, or a railway or bridge of a given length, without the slightest knowledge of the site of such works; for it is the local conditions which mainly determine their cost. Therefore I could not meet your challenge in a satisfactory manner unless we agreed on a certain locality, and I were to take the trouble and expense of surveying it, and preparing the necessary plans to enable a correct estimate to be formed. As this is out of the question, I am constrained to write somewhat vaguely; but if I failed to meet your challenge you would, of course, interpret the failure as an admission that the cost of tidal power would not bear a comparison with that of steam. Therefore, as a compromise between making a correct estimate for a certain locality, and a complete silence on the subject, I will venture to give a very rough, but at the same time a fair, estimate of the cost of a tidal dam to utilise 300-horse power for ten hours per day. It must, however, be understood that the quantities are only roughly calculated, and the prices are purely fictitious, but in both I have endeavoured to guard against the use of such figures as would place tidal power in a too favourable light. For the sake of simplicity we will suppose the range to average 24ft., and that the rise and fall is uniformly 4ft. per hour, so that a rest of two and a-half hours after the time of high or low-water would induce a difference of 10ft. between the levels of the water at each side of the dam. By employing motors of the requisite capacity, this head could be maintained constant for two hours and a-half, during which time the fall of the tide water would be utilised as it passed into or out of the enclosure formed by the dam. At the end of this time over half the water would remain to be passed during the hour before the next turn of the tide; its great velocity and decreasing head would render the fall of this portion difficult to utilise, so that it would doubtless in most cases be run to waste, but the current engendered by it could be used for scouring purposes.

In order to find the area which should be enclosed by a tidal dam to utilise 300-horse power for two and a-half hours nearly four times a day, let us suppose the efficiency of the motors to be 50 per cent., which can be done by assuming that 600 theoretical horse-power is required; 600-horse power developed for two hours and a-half, or 150 minutes, represents 33,000 × 600 × 150 = 2,970,000,000 foot-pounds of energy. As the head is 10ft., 297,000,000 lb. of water will be required, which is about 4,714,285 cubic feet; as this will only form a layer 10ft. deep in the enclosure, its area will require to be 471,428 square feet, or nearly eleven statute acres.

Suppose that the site of the tidal dam is across the entrance to an inlet of about this area, and that such entrance is two chains wide at high water, and about half a chain at low water. The middle portion of the dam up to the level of low water, would be formed by large cast iron cylinders, similar to those used for the foundations of bridges, but of a section suitable to the class of rotary motion pistons to be used in them. They would be 20ft. in depth, sunk 10ft. into the ground, and the lower part filled with concrete. From the level of the ground to that of low water they would have an opening at each side for the passage of the water to work the contained motors. These openings would be closed, and the cylinders raised by temporary extensions, to keep out the water during the progress of sinking them. In order to ascertain the number of motor cylinders required, the power of each must be found. Assuming that the periphery of each rotary piston would have a speed equal to two thirds of the natural velocity of the water due to a fall of 10ft., or $\sqrt{\frac{64 \times 10}{3}} \times 2 = 16{\cdot}8$ft. per second, and that they would describe a circle 19ft. in circumference, the number of revolutions per minute would be $\frac{16{\cdot}8 \times 60}{19} = 53$. As about 300 cubic feet of water would be passed per each complete revolution of the pistons, 300 × 53 = 15,900 cubic feet would be passed by each motor per minute. Assuming the weight of the water to be 63 lb. per cubic foot, and the fall 10ft., the theoretical horse-power of each would be $\frac{15{,}900 \times 63 \times 10}{33{,}000} = 303$, and the actual power $\frac{303}{2} = 151$, so that two motor cylinders would be quite sufficient. Another cylinder, containing a sluice to pass the waste water more quickly, would also be required, and the three would take about 30ft. of the length of the dam, leaving 51ft. of foreshore at each side of the cylinders. The foundation here would consist of two rows of sheeting piles, with the soil excavated from between them, and concrete substituted. The upper portion of the dam, extending from one shore to the other, and from low-water to above the level of the highest tides, would be constructed of ship-plates strengthened and stiffened by ribs and angle-irons; it would be somewhat similar to a large hollow girder, and could be built up in sections on the shore and floated into the required position, and securely attached to the piles and cylinders forming the foundations. This part of the dam would contain a horizontal shaft to receive the power from the vertical ones in the motors, and transmit it to the factory on shore. Lateral support would be afforded to the dam by shores from the heads of screw piles, a row of which would be driven at the requisite distance on each side; and timber fenders extending from low to high water would be attached to the screw piles at the exposed side of the dam, as a protection to it from storm or collision. A row of sheeting piles would also be driven entirely across the channel at each side of the dam to maintain the level of the bed and prevent the scour from endangering the foundations. This slight description of the supposed works will render more intelligible the following rough abstract of quantities and estimates; it must be understood that the prices given are supposed to include, besides the material, all charges for labour, superintendence, and plant.

The two motor cylinders would each weigh about 10 tons, and the sluice cylinder 8½ tons; the weight of the three would therefore be 28½ tons, which, at £20 per ton, would cost £570. The upper part of the dam would weigh about 55 cwt. per lineal yard, or, altogether, $\frac{55 \times 44}{20} = 121$ tons, which, at £15 per ton, would cost £1815. The screw piles would weigh about 14 cwt. each, and twenty-four would be required, so that the total weight would be 14 × 24 = 336 cwt., which, at £20 per ton, would cost £336. About 43 tons of shores or struts would be required, which, at £15, would cost £645; making a total of £3366 for all the structural ironwork. The machinery, which would include 90ft. of shafting, four spur, and six bevel wheels, the rotary pistons, and the sluice, and all necessary fittings connected with the same, may be roughly estimated to cost about £430. The two rows of sheeting piles driven down to the level of the bed of the channel, would require about 3168 cubic feet of timber, which at 5s. per cubic foot would cost £792. The sheeting piles forming the foundation of the dam on the foreshore would take about 3600 cubic feet of timber, which at 4s. would cost £720; and about 1250 cubic feet would be required for the fenders, which at 3s. would cost £187, making the total cost of the timber £1699. About 150 cubic yards of concrete would be required for each abutment, and 15 cubic yards in each cylinder, and 8 yards between them, making the total quantity required 393 cubic yards, which at £1 per yard would cost £393. Excavating between the sheeting piles on the foreshore, about 280 cubic yards at 3s., would cost £42, and dredging about 600 cubic yards from the channel so as to admit of the motor cylinders, would at 1s. per yard cost £30. The purchase of about 400 square yards of the foreshore at each end of the dam, at 1s. per yard, would cost £40. The summary will therefore be:—Structural ironwork, £3366; machinery, £430; timber, £1699; concrete, £393 excavating and dredging, £72; land, £40; total, £6000. A charge of 10 per cent. upon this capital would no doubt be sufficient for interest, attendance, repairs, and depreciation, as the latter would not be great, as the structure would be of a substantial and permanent character. The annual cost of the power would thus be £600, or £2 per horse-power per annum, for which it could be had for nearly ten hours per day, as many days per year as required. I must here draw attention to the fact that the amount of power under discussion is far too small to be utilised economically by a tidal dam, although it could probably be produced by steam at as low a cost as a larger amount; indeed, the case of a tidal dam to utilise 300-horse power is somewhat analogous to that of steam plant to produce two or three horse-power, and is therefore no criterion of the cost of tidal power utilised on a large scale. For instance, it will be found that over two-thirds of the above estimate is for what may be termed the abutments of the dam on the foreshore, and that though a capital of £20 per horse-power would be sunk in the works, only about £6 10s. per horse-power would be for that portion of the dam by which the power is utilised. The cost of the power would therefore be much less if utilised on a larger scale, even if a further percentage of the power had to be deducted for loss in transmission, by the length of the dam necessitating the employment of steel wire cables, or some other less economical means than a shaft for the purpose. The best financial results from the utilisation of tidal power would be obtained where its amount would be thousands instead of hundreds of horse-power, and where the local conditions favour the construction of the dam, and especially where the latter could also be made of profitable use as a means of communication between the opposite shores of the inlet. From the slight description given it will be understood how its wide base would render the dam easily adapted, by the addition of little more than the necessary decks or platforms, to carry either a road or railway, or even both; one at each side of the dam proper, supported by it and by pillars from the screw piles, to which the shores are attached. In many cases their use in this way would be so important as to justify the expenditure of a large portion of the capital, and enable the power to be sold much cheaper than it otherwise could. It is where the circumstances are thus favourable that the power could be had for so much less than steam as to counteract the slight disadvantage arising from its intermittent character, and make it worth while to establish factories in the neighbourhood of the dam. In most places where tidal power is obtainable there would be the additional advantage of proximity to a seaport, the importance of which is shown by the manufacturers' evidence in favour of the Manchester ship canal. This combined with cheap power should be sufficient, at any rate, to lead to the establishment of works where the material dealt with and the power required are great in comparison with the amount of skilled labour required.

The average annual cost of 300-horse power ten hours per day produced by steam is very difficult to estimate, as the consumption of fuel per indicated horse-power varies so much according to the plant employed, and the cost of fuel is also very different in different localities. Therefore, instead of making an estimate myself, I will take that of Sir W. Thomson, who, when speaking adversely on this subject at the meeting of the British Association in 1881, seemed to estimate the cost of steam power—produced continuously day and night—at about £10 per horse-power per annum; that is, at the rate of £5 per horse-power per annum for twelve hours per day, or about double my estimate for tidal power.

If any of your readers deem this subject worthy of discussion, I should like to be informed whether the prices I have given for the various kinds of work are considered fair ones under average conditions, and also what may be taken as the average cost of steam power per indicated horse-power per annum when produced on a large scale, including, besides the cost of fuel, all charges for plant and attendance. I do not, of course, contend that tidal power could compete with steam under any circumstances, but I believe that it could do so if utilised on a large scale under favourable conditions. I also maintain that the tidal dam is the most economical means of obtaining it. The only other way of utilising on a large scale worthy of practical consideration is the old and costly method of constructing artificial basins on shore, which would necessitate, besides the expenditure on the motors, the purchase and excavation of the site of the reservoir, which would entail a very great additional cost which would be avoided by the use of a tidal dam. Although I am far from having exhausted this subject, I hope I have succeeded in showing that it is one not altogether unworthy of the consideration of practical engineers and capitalists.

ARTHUR OATES.

September 8th.

TIDAL ACTION.

SIR,—The tidal phenomena of the Irish sea are of great importance, and illustrate on a large scale the action of the tide in rivers. Not only is there the extreme variation in the range, of which I gave instances in my last for the purpose of drawing attention, but, as Admiral Beechey reported in 1847, in "Phil. Trans.," notwithstanding the variety of times of high-water throughout the channel the turn of the stream is simultaneous. The northern and southern streams, he says, commence and end, practically speaking, at the same time, which corresponds with the time of high and low water on the shore in Morecambe Bay; an estuary remarkable as being the confluence of the tides coming round the extremities of Ireland—that is, when it is high-water off the Scilly Isles at 4.30 it is low-water in Morecambe Bay, high-water there being at 11.26, or seven hours later, from which it follows, when the ebb begins in that bay, the flood is rising at the Scilly Isles, and the incoming flood must meet the ebb somewhere between those places. The lines of high-water and low-water are perpetually advancing or retreating, and it is impossible for all the molecules, assisting to form high-water at Morecambe, to reach the Scilly Isles during the succeeding ebb; they arrive there in detachments in various succeeding ebbs, and oscillate backwards and forwards, with ever increasing proximity to the outlet of final discharge. Thus there is always a volume of water in oscillation, which varies in size with the age of the tide, and in composition with the rate at which the molecules are changed.

Again, in that portion of the Irish sea which resembles a lake, being to a large extent land-locked, the time of high-water on prominent parts of the coast is almost simultaneous—that is, when it is high-water at Holyhead at 10.11, the times are at Trwyn Du 10.13; Air Point, river Dee, 10.54; N.-W. light vessel, Liverpool Bay, 10.50; Formby Point, river Mersey, 10.35; Mull of Cantire, 10.35; Red Bay, 10.31; Killard Point, Strangford Lough, 10.53; Dundalk, 10.56; Balbriggan, 10.40; Dalkey Island and Bray Head, 10.45. It is quite impossible for all the water occupying the depth of the tidal range to be discharged through the two outlets, namely, between Holyhead and Dalkey Island, and the straits between the Mull of Cantire and Torhead.

The question naturally arises, whither is the residue of the water carried? Clearly into the lower reaches of the various rivers and streams which debouch into the basin, whence, after assisting the upland waters to rise to their highest level, it returns to augment the young flood in that part of the Irish Sea defined above, which, and not Morecambe Bay, is the actual area over which the tidal confluence extends. Meanwhile, as suggested by Mr. Hurtzig, the line of high water advances up the rivers, the tide turning back and damming up the land waters until that level is attained, whence they flow or ebb out to sea, being the top of the tide. The ebb, then, is due to gravitation, and the tide to a mechanical power which is always advancing and pushing backwards the opposing waters, until the surface of high water is uniform with that of the river at the line of meeting; the level and position of those services varying with the energy of the force, that is, with the age of the tide. It seems to me very erroneous to regard the tide as an impulsive or intermittent force; it is, rather, a steady pressure, which varies somewhat as local conditions vary, but on the whole is persistent, as may be conceived of a double weir, so elastic as to accommodate itself to every irregularity in the sides or bottom of the channel through which it is propelled. The oscillating volume of water acts as a dredge in maintaining the channels through which it is forced to and fro. Where a given depth is required the height of the volume should be equivalent; that is, if the channel is too shallow, it must be deepened artificially, and usually the volume of water so augmented will suffice, with or without occasional assistance. It is much more difficult to prescribe the length and width of the channel, though the latter may usually suffice if adequate for the traffic through it. But for the length there do not appear to be adequate data; only, if it is insufficient, silt will accumulate at the upper end and reduce the volume, unless removed as it accumulates, but it is obviously more economical in general to employ natural forces so long as they are available.

These considerations may, perhaps, induce Mr. Hurtzig to modify his opinions upon the importance of maintaining the tidal capacity of a river unimpaired, or of increasing it when the entrance to a river is to be improved or preserved from deterioration. Hitherto the distinction between tideless and tidal rivers appears to have been frequently overlooked; in the former the erosion and carriage of silt is uniformly in one direction, in the latter they are reversed three times in thirteen hours, a condition which should influence the theory of such rivers very materially. Further, the distinction between the tide and tidal currents should be rigidly observed; the latter, like the ebb, are caused by gravitation.

JOSEPH BOULT.

Liverpool, September 13th.

INDIAN RAILWAY GOVERNMENT CONTRACTS.

SIR,—In reference to recent correspondence in your columns, I subjoin an extract from the *Pioneer Mail* of August 3rd last. This is the weekly edition, published for despatch to Europe, of the Allahabad journal, the *Pioneer*, the foremost of the Anglo-Indian daily press, having the largest circulation of any newspaper in India, and generally acknowledged to be thoroughly well informed; indeed, it is currently supposed to derive much inspiration from high Government officials and the Civil Service generally. I, therefore, leave your readers to form their own estimate of how far its statements may be taken to be in accordance with fact. My own opinion is decidedly that the *Pioneer* would never risk its reputation in making statements it was unable to substantiate, and that, at all events, it accurately reflects the opinions entertained by the Government of India, formed, of course, on information derived direct from the India-office, Whitehall. Perhaps you or some of your readers may have something to say on this new view of the matter:—

"Some of our readers may have noticed that an outcry was lately made in the House of Commons against the India-office for having given out a small contract for axle-boxes to a foreign firm. It now appears that there is a good deal more behind, and that the India-office has been forced to this line in self-defence, owing to a combination by a 'ring' of ironmasters to keep up the figures of tenders for ironwork for India. Seeing that both Germany and Belgium are now able to turn out iron and steel work as good and as cheap as that to be had in England, this course seems simply suicidal, and particularly when tried against such a rich and powerful customer as the Indian Government. Indeed, Mr. Rendel, little as he likes foreign work, is reported to have said that the India-office could afford to wait until orders had accumulated up to even a hundred thousand tons, and that then, perhaps, the 'Syndicate' would be ready to come to terms. The whole matter points strongly to the wisdom of Mr. Hope's proposal, viz., to encourage some good firm to make iron out here for Indian railways on rates to be fixed yearly on the basis of the current rates at home. This proposal is known to have been brought to nought by the influence of the English ironmasters, and now we find them 'trying it on' at home."

For the benefit of some of your readers, I may add that the Messrs. Rendel and Hope alluded to in the preceding extract are respectively Mr. A. M. Rendel, consulting engineer for State Railways to the Secretary of State for India—and for several Indian railway companies—and the Honourable T. C. Hope, C.S.I., member of the Viceroy's Council for Public Works.

September 12th. A READER OF THE "PIONEER."

THE PROSPECTS OF YOUNG ENGINEERS.

SIR,—Referring to the correspondence appearing in your paper respecting the training, or want of training, of young engineers, and subsequent difficulty in finding employment, is not the fault to a large extent with guardians and pupils themselves. These alike seek the most influential firms with the largest works, where they are not wanted; and where, if obstacles are not placed directly in their way, nothing is done to help them to information. Were they content to acquire the ground work of their business or profession in a smaller shop, in return for a moderate premium, say £100, they would find many thoroughly capable engineers who would look after and properly instruct them, not only in the technical department, but also, if wished, in the not less important financial branch. A lad commencing such a training at sixteen or seventeen would have no difficulty in securing £90 or £100 a year by the time he was one or two and twenty, and would then be in the way of securing the experience which would make his services really valuable.

It is a mistake to suppose because a firm is small it must be behind the time. The fact is, such firms are hardest pressed by competition and have to be keenly alive or they would not be among those left by the survival of the fittest.

September 15th. A SMALL M.E.

STRESS DIAGRAMS.

SIR,—With reference to recent letters on this subject, I beg to offer the following as, I believe, the most correct view of the question:—The girder should be considered as a combination of the type with vertical struts and diagonal ties, and that with vertical ties and diagonal struts, the stresses being divided equally between the two systems. Suppose a girder to be designed to carry a uniform load of W at each apex on the bottom flange. Diagram 1 shows the stresses caused by half these weights acting on the lines of the former; Diagram 2 the remaining half, according to the latter type. Diagram 3 shows the complete girder compounded

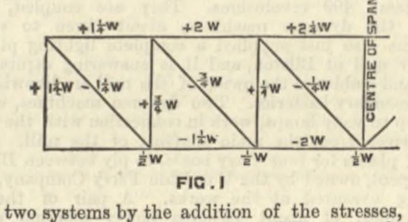


FIG. 1

from the two systems by the addition of the stresses, the sign − indicating tension and + compression. Where members of opposite strains coincide, as in the case of the verticals, the excess of tension over compression, or *vice versâ*, is the stress to be provided for—that is to say, the "algebraical" sum in every case. The figures on the diagonals represent the vertical components of the

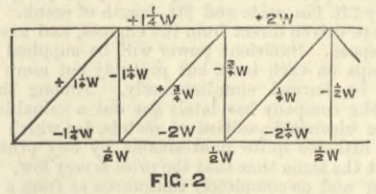


FIG. 2

stresses, but the bays in the diagrams being supposed to be of equal breadth and height, they are correct for horizontal stresses also, and the stress on the flanges is derived from them. An extension of the principle of these diagrams will show that the stress on each vertical is—in the case of unequal as well as uniform weights—equal to half the weight W at its termination. A girder loaded on the top flange would have the verticals in compression to a

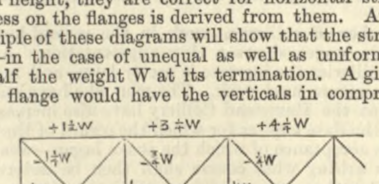


FIG. 3

similar extent; while in case of a weight being absent at any vertical on an equal weight at top and bottom, the vertical would be without strain.

As I have seen it stated that in girders of this description—the Charing-cross Bridge, for example—the verticals bear no strain, I should be glad to know if these conclusions are open to contradiction.

W. B.

September 8th.

SIR,—In reply to the remarks of your correspondents upon my letter on this subject, which appear in your issue of 29th August, I would make the following observations.

The general statement is quite true, without going to American practice to prove it, that the most economical form of girder is that which has the verticals in compression; but this, however, supposes that the verticals are legitimately struts, as in Fig. 1 in the middle column of page 178. In Fig. 2 they are legitimately ties. It does not follow that, in the form of girder under consideration, less metal will be required if the verticals only are made struts. The reverse is really the case, and if two girders were made of equal strength—one with the verticals only braced, and the other designed to agree with my method of calculation, the latter would be the lightest by about 20 per cent.

In this girder, with a double set of diagonals crossing each other, the verticals are not always legitimately struts, but the nature of the stress in them depends on the position of the load. If the load is on the bottom, they are all ties; if on the top, they are all struts, and in either case the stress is uniform in all the verticals, and is equal to half the unit of load, or load per bay of the girder, *i.e.*, for an ordinary girder subjected to an equally distributed load. The verticals can hardly be called useless, for they make the + and − stresses in each pair of diagonals in any one bay of the girder equal in amount. I do not advocate this kind of design, but if, for the sake of appearance, or any other reason, it is adopted, it will be most economical to calculate the stresses in the manner I have indicated, and place the metal used in construction accordingly.

With regard to the difference which "C. S." observes between my method and Mr. Graham's, it may be satisfactory to him to know that, although we go to work in different manners, we arrive at the same results as far as I can see.

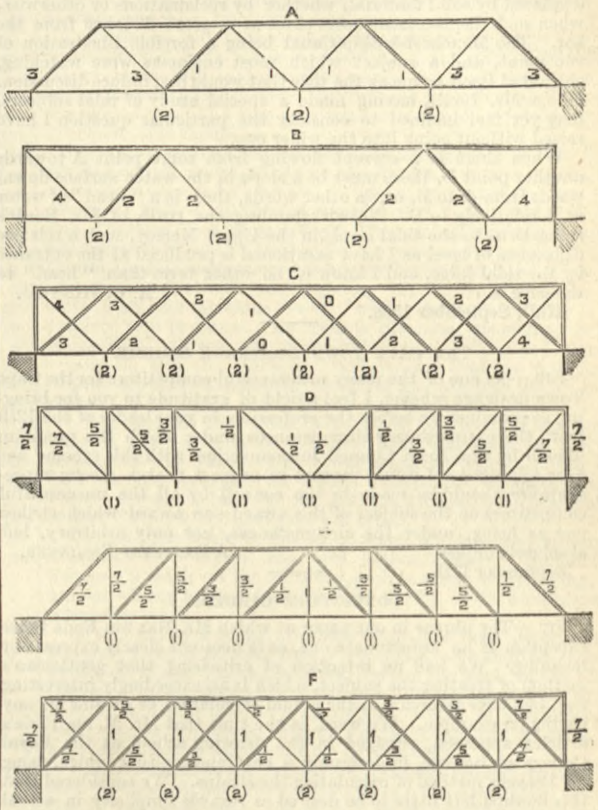
In your paper of June 20th, 1884, page 457, there are equal amounts of compression and tension in each of the verticals Nos. 8 and 16, showing that there is no stress in either of them; and the compression minus the tension in verticals. No. 12 gives a net compression of $1\frac{1}{2}$ tons, or half the load over the vertical. In vertical No. 20 the same amount of compression has been taken.

CHARLES LEAN.

Palace-chambers, 9, Bridge-street, Westminster,
London, September 8th.

STRAINS ON LATTICE GIRDERS.

SIR,—Having seen several letters in THE ENGINEER about strains on lattice bars, I thought I should like to try my hand at explaining, in the easiest way, the difference in the strains on lattice bars in girders, with and without vertical bars.



On the sketch inclosed the numbers are the vertical components of the strains, and would have to be multiplied by the cosec of the angle with the vertical for the actual strain. Let A and B be two single lattice girders, and the strains will be as shown. Put the two together, and the result C will be a lattice girder without vertical bars.

F, a girder with vertical bars, is a combination of the simpler forms D and E. The double lines are for bars in compression, and in F the strain on the vertical bars is the difference between the strains on those in D and E. I hope the sketch will explain itself.

H. C. R.

6, Westminster-chambers, Westminster,
September 1st.

LOCOMOTIVE CRANK AXLES.

SIR,—In your editorial of the 5th inst., on outside and inside-cylinder locomotives, you state: "When iron axles were in use there was some ground for this opinion, because it was more difficult to make a crank axle sound than a straight axle; but since steel was introduced this argument ceases to have any force."

May I ask, why so? As a maker of both, I have yet to learn that a sound iron axle is not easier to make than one of steel. The time has now arrived when facts obtained from practical use will settle many theories on this question.

The Board of Trade returns for the year ending 1883 show that 245 locomotive crank axles failed. Of these, 173 were of iron, which gave an average mileage of 213,719 miles; 72 were of steel, the average mileage of which was 199,471 miles, thus showing a difference of 14,248 miles per axle in favour of iron.

These figures do not prove, to my mind, that for the purpose of crank axles anything has yet been gained by the substitution of steel for iron.

N. P.

September 9th.

LINKS IN THE HISTORY OF THE LOCOMOTIVE.

SIR,—In your issue of the 12th you request any information relative to the Rocket of 1829. I was born at Darlington in the early portion of the present century. My father, a surgeon, left Darlington about 1820 for Ilford—where he died in 1870—I being sent back to Darlington, where my grandfather was still living, to receive my preliminary education at the grammar school. I can well and distinctly recollect riding on the Stockton and Darlington Railway, being drawn by horse there and back, accompanied by my grandmother and my Aunt Millbank. My grandfather was intimately connected with the Pease family, and also with Timothy Hackworth. Now, I must tell you that, as a child, even during the dentition period, which is generally anything but a peaceful one, even to the nurse, that nothing but the town pump which stood opposite to the house in Skinnergate, and the cuckoo clock in the kitchen, produced anything like quiet—this fact may induce you to come to the conclusion that at that early period of my existence there was a mechanical tendency in the system—Mr. Hackworth's foundry was always a source of the greatest delight to me, being always there whenever opportunity offered. Now, very long—but how long I cannot now say, but about five years—there were locomotives drawing coal wagons on the railway, and these we called "puffing Billys." The boilers were, I believe, of cast iron. They had return tubes, the fire being at one end, the chimney at the other, with an ornamental vandyked top, and a large barrel for water tender. There were small windmills for the supply of these tenders. These engines had two cylinders let into the boiler, the top covers being just above the shell of the boiler. The piston-rod was attached to a crosshead, which reached across the boiler, and two wooden connecting rods were connected to two pins in the cast iron wheels of the engine. The rails upon which the engine ran were attached to stone sleepers. In the autumn of 1825 an engine was used to draw the passenger carriage. This engine had vertical cylinders, and was made at T. Hackworth's. At all events, in his foundry, shortly after this, an engine precisely like the Rocket was used, and to this engine I owe my first knowledge of the slide valve, Mr. Hackworth explaining its action to me. This engine had no fire-box proper, being of the same kind as the puffing Billys. Some three or four years after this I well recollect the alteration or addition of the fire-box being bolted on to the front of the boiler and tubes being used, and this improvement was due to a Mr. Booth; and I perfectly recollect the verdict of all present at Rainhill, that to this improvement the success of the Rocket was entirely due. The first engine that I ever saw with the fire-box as shown in Mr. Nasmyth's drawing, was in Braithwaite and Erricson's shop during a holiday visit to my father in 1829, I having made the voyage from Stockton to London in the Majestic steamboat. RICHARD ALLISON.

Stoke, Ipswich, September 13th.

THE MANCHESTER SHIP CANAL.

SIR,—I was glad to see in your last issue a few remarks from Mr. Joseph Boult. I cannot, however, agree with him as to the title under which the discussion should proceed. He would open the very wide question of the genesis of tides and peculiarities of tidal action generally. Interesting as it is, it is one into the consideration of which I, for one, am not prepared to enter. My letter to you was written to invite attention to a point in river engineering that seems to me not quite satisfactorily established, viz., the notion that the quantity of water passing into an estuary over the bar will be diminished in proportion to the amount of water displaced by solid material, whether by reclamations or otherwise, when such displacement takes place at a great distance from the bar. The Manchester Ship Canal being a forcible illustration of the point, and a subject which most engineers were watching, suggested itself to me as the title that would best induce discussion. I hope Mr. Boult, having made a special study of tidal subjects, may yet feel inclined to consider the particular question I have raised without going into the wider one.

When there is a current flowing from some point A towards another point B, there must be a slope in the water surface downwards from A to B, or, in other words, there is a "head" of water at A relatively to B. Notwithstanding the truth of Mr. Boult's remarks as to the tidal levels in the Upper Mersey, such a relative difference of level as I have mentioned is produced at the entrance by the tidal force, and I know of no other term than "head" to describe it. A. C. HURTZIG.

Hull, September 15th.

THE CAPE TOWN DRAINAGE SCHEME.

SIR,—As one of the many unsuccessful competitors for the Cape Town drainage scheme, I feel a debt of gratitude to you for bringing so prominently before the profession, in your leader of the 12th inst., the extraordinary circumstances under which the premium offered by the Town Council in connection with this scheme has been adjudged. I would venture to suggest that a strong representation should be made to the council by all the unsuccessful competitors on the subject of this award—an award which strikes one as being, under the circumstances, not only arbitrary, but absolutely unjust. A SANITARY ENGINEER.

September 17th.

CONTINUOUS GIRDERS.

SIR,—The phrase in our paper at which Mr. Max am Ende takes exception is an unfortunate one, as it does not clearly express our meaning. We had no intention of criticising that gentleman's method of treating the subject, which is an exceedingly interesting one, but were referring to the actual calculation of strains in any particular example. We were, at the time that Mr. M. am Ende's articles appeared, engaged in the drawing school at the Royal College of Science, in designing a continuous girder bridge, using M. Bresse's method of calculating the strains. We considered that this method left little to be desired as regards simplicity in actual calculation; and we thought that a short paper on it would be interesting to some members of the profession, and form a supplement to the articles that had already appeared.

Mr. Max am Ende charges us with saying that the method by which he established his results was "troublesome and confusing," whereas we merely say that we consider that his system would be found difficult of application, which is quite a matter on which every one is entitled to his own opinion.

As the title of our paper indicates, our object is to show how girders can be calculated by means of the theorem of the three moments, and for this purpose we take a simple example as being more easily understood than a more complex one; while the principles involved will be the same in any case.

The wording of the last paragraph in our paper is not all that could be desired, though we think that few persons will misunderstand it. Perhaps it would be better to substitute for the words "result of unequal loading," in line 15, "The effect of the rolling load." T. K. MACKENZIE.

September 17th. J. E. TURNER.

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

(*From our own Correspondent.*)

THE somewhat better state of trade is this week fully maintained. A correct indication of the improved condition of the sheet branch is found in the circumstance that ironmasters in several parts of the district are setting on additional mills, and at some works there are now five such mills running fully from Monday night up to Saturday afternoon. The orders for sheets for galvanising continue to arrive freely, and numerous buyers are demanding prompt deliveries. This looks well; and the same feature characterises many of the orders arriving from merchants in London, Liverpool, and elsewhere, intended for export. Orders from this source are increasing, and if this feature of the trade continues, a substantial advance in prices may before long be looked for.

Already, according to the reports brought on 'Change this week, some merchants, who desire prompt supplies, are offering an advance of between 2s. 6d. and 5s. per ton. Makers who are in the receipt of such offers are firm in price, and are quoting £7 to £7 5s. for singles, £7 10s. to £7 12s. 6d. and £7 15s. for doubles, and £1 additional for lattens. The best export market at date is Australia. The Indian demand is quiet, but some orders by cable are anticipated shortly.

Woodford sheets of 20 gauge, delivered at out ports, are quoted £8 5s.; 24 gauge, £9 15s.; 26 gauge, £11 5s.; and 28 gauge, £11 15s. Woodford crown close annealed sheets are £9 10s. for 20 gauge; £11 for 24 gauge; £12 10s. for 26 gauge; and £13 for 28 gauge. Best qualities are £11, £12 10s., £14, and £14 10s., according to gauge; best best are an additional 30s. per ton; and trebles a still further 40s. per ton extra. Siemens-Martin close annealed steel sheets are £13, £14 10s., £16, £16 10s. according to gauge. Woodford charcoal sheets are £16 for 20 gauge, £17 10s. for 24 gauge, £19 for 26 gauge, and £19 10s. for 28 gauge, delivered Liverpool or London.

The demand for bars is no worse than a week ago; if anything, it is perhaps a little better. Makers of common sorts are here and there securing 2s. 6d. per ton advance, but others again find that such an attempt checks orders. Common bars are now generally priced at £6. Marked bars maintain their ground on the basis of £7 10s. to £7 per ton.

Best Corngreaves angle bars, from 1in. by 1in. by ¼in., and up to 8 united inches, and 25ft. long, are quoted £7; "Lion" ditto, £8 5s.; best Lion, £9 15s. Best Corngreaves T-bars, 1¼in. by 1¼in. by 1¼in., and 21ft. long, are £7; Lion ditto, £8 10s.; and best Lion, £10. Best Corngreaves window-sash bars, from ⅝in. to 3in. wide, are £8 10s.; Lion ditto, £9; best Corngreaves horseshoe bars, £6 10s.; Lion ditto, £7 10s.; and best ditto, £9. Fancy irons, such as oval, convex, half-round, round cornered, round edged, bevelled, and beaded tire bars, are also £6 10s., £7 10s., and £9, according to brand.

Strip and hoop makers report a larger business in nail making and gas tube and bedstead strip. The former is being turned out in steel in considerable quantities, and is going mainly to local consumers. Such strips are at the present time being rolled largely out of old rails and railway tires, and while this process of manufacture is very economical, the quality of the article produced is all that can be desired. The demand for gas tube strip is increasing, consequent upon the approach of the season when the gas companies look to be busy. Steel nail strip was quoted this—Thursday—afternoon in Birmingham at £7 5s. to £7 10s. per ton, and superior steel strip for weldless tubes £10. Iron gas tube strip was £5 15s. upwards; iron bedstead strip, £6; and iron tube strip for bedsteads, £7 10s. With gas tubes selling at the present time at, in some cases, only £8 per ton net, these prices for the raw material can leave but a very scanty margin of profit to the tube maker. Nor can it be said that the profit made by the strip producer is scarcely less unsatisfactory.

There is but little business coming into this district at present from the United States in any department, but a few firms hope by-and-bye to be in receipt of some American orders arising out of visits which certain of the principals are just now about to make to the States.

Satisfaction is expressed that the telegraphed reports from New South Wales indicate a maintenance of the revival in Sydney; but it is yet too early for the mail orders to show much improvement. Galvanised sheet makers complain that the prices attached to indented orders are such that in many cases they have to be refused.

The heavy purchases of pigs which have taken place during the past two or three weeks seem for the present to have pretty much satisfied consumers' needs. One Derbyshire Company boasts of having booked 20,000 tons during the past three weeks or so, which means a five months' make. There is little or no fresh buying at the moment, but prices are upheld at the recent advance. Good Derbyshires are quoted at 42s. 6d. at stations, and Northamptons about 41s. 6d. Native pigs are quoted at 40s. to 37s. 6d. for common sorts, and 42s. 6d. to 45s. for part mines.

Messrs. Thomas and Bettridge have offered for sale in Birmingham this week the Union Furnaces, situated at Albion, West Bromwich. The lot included three blast furnaces, colliery plant, and block of building. The bidding only reaching £11,725, the property was withdrawn.

Constructive engineers are not in receipt of many new contracts of importance. Yet at Wednesbury in particular a lot of bridge and other railway work is being turned out for India, and delivery is pressed. A fresh indication of the severe competition to which this district is at present subject in some of the leading industries is afforded in the circumstance that steam cranes are now being delivered from Scotland, for erection at Wolverhampton, at considerably lower prices than local makers quote.

Orders for electric light machinery are coming forward with activity, and electric engineers regard prospects as better at date than at any time for two years past. The first instance of an ironworks—certainly in this district—being lighted upon the incandescent principle, is furnished in the contract which the Wolverhampton Electric Light, Storage, and Engineering Company has just completed at the Spring Vale blast furnaces of Mr. Alfred Hickman. There some 250 lamps, of 20-candle power, are burning every night for eight hours continuously—a pretty severe test for a new plant. A great many of the lamps are grouped, and they may possibly by-and-bye be changed to 50, or even greater, candle-power. The light is generated by two dynamo machines, equal to 130 lamps each, driven by a pair of the Parker-Elwell high-speed single-acting engines of 25-horse power. The engines have been built by the Coalbrookdale Company, and run at about 400 revolutions. They are coupled, and are geared to the dynamo machines, about three to one. The company has also just supplied a complete lighting plant for a steam flour mill at Bilston, and it is answering capitally. The residence and stables of the owner of the mill are likewise lighted up from secondary batteries. Two dynamo machines, which will each run up to sixty lamps, work in connection with the batteries, and are driven from the main shafting of the mill. Complete generating plants for four ferry boats, to ply between Birkenhead and Liverpool, owned by the Woodside Ferry Company, are likewise being executed at the works. A pair of the Parker-Elwell engines, of about 12-horse power nominal each, are to be put on board each boat. The cylinders are set at equal angles apart, around one crank, and the crank is entirely enclosed in an exhaust chamber, to which the ends of each cylinder are open. The engines are of the high speed type, and will run about 600 revolutions per minute. They are very compact, only standing 3ft. high by 2ft. 6in. wide and 2ft. length of crank. The dynamo machines are driven direct from the engines, and are made to run at a slow speed. Sufficient power will be supplied to light 100 Edison lamps on each boat, but probably not more than fifty or sixty will be burned simultaneously. Among their dynamo machines the company has lately got out a valuable new patent machine for electric deposition of metals, for which they claim a perfection hitherto quite unattainable by any other deposition machine, at the same time that the price is very low. The current is as regular and as completely continuous as from a battery, and the quantity is very large. No governor is required, the machines are non-reversible, and take less power to drive than other dynamo machines.

The number of colliers at work in the several localities at the reduction in wages shows a slow augmentation. At the Earl of Dudley's collieries the increase is pretty large, and more men are expected to return next week. The men who have resumed at the reduction at the Hamstead Colliery have also increased. On the 27th inst. the date expires for which the award of the arbitrator—against the acceptance of which the strike began—was made. The question is arising what course shall then be determined upon. The men, it is clear, are wishful of coming to terms and bringing the struggle to a close. At a mass meeting at Dudley on Wednesday, at which the chief delegates were present, it was resolved to ask the masters to send twelve gentlemen to meet a similar number of miners' delegates to discuss what shall be done after the 27th inst.

Mr. Joseph W. Williams presided on Wednesday over a Court of Mines' Drainage Commissioners held in Wolverhampton, to hear appeals against the assessment made by them of the tonnage of minerals raised for the half-year ended June 30th last, at the various collieries throughout the Commissioners' area. There were no fewer than thirty-five appellants, the greater number of whom were from the Tipton district. Although primarily the assessed tonnage bears a rate of 1d. per ton for surface drainage purposes, the mines' drainage rate is also assessed on it. Hence the importance of the appeals. The proceedings were private.

Six of the eleven miners injured by the explosion at the Hall End Colliery, West Bromwich, on the 6th inst., have now died, and several of the others lie in a critical condition. The inquest was opened at West Bromwich on Tuesday, but it was adjourned, after merely formal evidence had been given, until the 1st prox.

The paper of chief trade interest in connection with the meeting of the Social Science Congress, now being held in Birmingham, is that "On the South Staffordshire Iron Trade, its Position and Prospects," by Mr. Smith Casson, manager of the Earl of Dudley's Round Oak Ironworks and vice-president of the South Staffordshire Iron and Steel Managers' Institute. Mr. Casson is also the inventor and patentee of the Casson-Bicheroux gas-heating furnace. Many leading firms in the town and neighbourhood have thrown open their works to visitors, and the excursions are proving very attractive to large numbers.

The members of the Associated Chambers of Commerce who may attend the meeting in Wolverhampton, which begins on the 30th inst., are to have an opportunity of witnessing the making of steel by the Bessemer basic process at the works of the Staffordshire Company. A special train has been chartered for the excursion, and the members will then be taken on to the limestone caverns of the Earl of Dudley, which are to be illuminated. His lordship will entertain the party at luncheon. The guarantee fund for entertaining the members in Wolverhampton amounts to £1340.

This week an exhibition of gas appliances has been opened at West Bromwich.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—So far as prices are concerned, a steady tone is being maintained in the iron market here, and if anything a rather better feeling seems to prevail, but the weight of actual business doing continues small, and it cannot be said that there is any real improvement in the condition of trade. To the extent that there is more disposition on the part of buyers to give out orders at the very low prices that makers have recently taken where they have been anxious to secure orders to keep works going, the pig iron trade may perhaps be said to be better; and if these prices could be made the basis of transactions, no doubt a considerable business could be done for long forward delivery, but consumers do not see any advantage in committing themselves very largely far ahead at unremunerative rates, and where they are not absolutely in want of orders they are holding out for more money. Some brands, such as Derbyshire, could not now be bought within 1s. 6d. per ton of the prices that were being taken a few weeks back, and for Lincolnshire brands 6d. to 1s. per ton more money is being asked. Any advance in prices is, however, little more than nominal, as it is not followed by buyers; whilst makers, as they are compelled to come into the market, meet buyers with low prices, and there is comparatively very little business being done, except at the minimum rates. Manufactured iron makers are maintaining a tolerably firm tone on the basis of the low prices that have been ruling for some time past; but with a margin of production over requirements, it is only with difficulty they are able to resist further concessions, and in some cases merchants are underselling.

There was again a very quiet market at Manchester on Tuesday, and an absence of demand was generally reported. For Lancashire pig iron quotations remained at 41s. for forge and 42s. for foundry, less 2½ per cent. delivered equal to Manchester, and makers decline to entertain offers at below these figures. Lincolnshire brands average about 41s. 6d. to 42s. 6d., less 2½ delivered here, but a little less is being taken in some cases by needy sellers. Derbyshire iron is quoted at 43s. to 44s., less 2½ delivered here, but at these figures it is practically out of this market. Outside brands are without material change so far as makers' prices are concerned, with, however, very little doing in this market either in Scotch or Middlesbrough, beyond occasional parcels that are bought for special requirements.

Hematites still meet with little or no inquiry, and there are good foundry brands to be bought readily at 53s. 6d. to 54s. per ton, less 2½ delivered into this district.

In the manufactured iron trade a moderate business is reported, and makers are holding firmly to £5 12s. 6d. as the minimum for good qualities of bars delivered into this district, but I have heard of as low as £5 10s. being taken for a fairly large quantity of a good brand, which indicates that in some quarters at least prices are expected to come lower. Lancashire hoops can still be got at £6, although some makers quote £6 2s. 6d., and sheets at £7 for singles and £8 for doubles, delivered into the Manchester district.

The condition of the engineering trades remains much the same as I have last reported. The returns of the Amalgamated Society of Engineers show no appreciable alteration in the state of employment, the number of out of work members on the books remaining at about 3½ per cent. In the Manchester district one or two large firms are reported to be going on short time, and the general tone of the branch reports as to the state of trade is that it is quiet, with a tendency to decline.

A new steam engine governor of very simple construction, but, at the same time, efficient in its operation under varying loads, has been introduced by Messrs. Deakin and Parker, of Manchester. This governor, which has been patented by Mr. Lindley, is termed the "Acme," and it is free from the complications which are so great an objection in many of the types of governors now in use. This is partly secured by the introduction of tension springs, attached directly to the revolving weights, instead of acting on them through the intervention of levers and joints, with their necessary friction and wear, whilst these tension springs at once ensure that sensitiveness which is essential in a good governor. The running joint by which the motion is given to the valve spindle is at the top, where it is easily oiled, and can be at once exposed to view, whilst, if necessary, the spindle can be raised or lowered by unscrewing a cap at the top of the governor. The links that transmit the motion from the weights to the governor have nothing to do except move the spindle, and they are thus free from all strains. The equilibrium valve is in perfect balance, and offers only the slightest resistance to the motion of the governor and the hemispherical flyers being made of great weight, a large reserve of power is secured. These governors are constructed to work either horizontally, vertically, or upside down, and they are also made in horizontal form. They are specially adaptable, and have already been applied with successful results to engines used in generating the power for electric lighting, and a "speeder" which has been attached, by means of which the speed of the engine can be increased or decreased 25 per cent. by simply turning a small screw head attached to the governor, is a feature that will recommend it for adoption on electric driving engines. I may add that Messrs. Deakin and Parker are also making special engines for electric driving, and capable of running up to 250 revolutions per minute. Several of these engines have been supplied to the large Atlantic and Indian steamships. They are fitted with an automatic lubrication for all the working parts, and it has been found possible to run them continuously for a month without difficulty.

In the coal trade business is only moderate, and in most cases colliers are still working four days a week, with stocks being put down at many of the pits. The demand for house fire coals has somewhat quieted down with the warmer weather, and there is not as yet any large buying for winter requirements. Common round coals continue only in dull demand for iron-making and general trade purposes. Engine classes of fuel move off only slowly, and the common qualities of slack are becoming a drug in the market, with prices tending downwards. For house fire coal prices are fairly steady at 9s. for best, and 7s. for seconds at the pit mouth, but 6d. under these figures is still being taken in some cases; common round coals average 5s. 6d. to 6s.; burgy, 4s. 6d. to 5s.; good slack, about 4s.: and common sorts, 3s. to 3s. 6d. per ton at the pit.

Shipping is fairly good, but not quite so active as it has been, and 7s. 3d. per ton is about the average price that is being got for good ordinary qualities of Lancashire steam coal delivered at the high level, Liverpool, or the Garston Docks.

For coke there is only a limited demand, and common local makes can be bought at the ovens at about 8s. per ton, with the better qualities fetching 10s. up to 12s. per ton.

Barrow.—In the hematite pig iron trade of this district I have to report a still quiet and unsatisfactory condition of affairs. Business has in no way improved during the week, the orders to hand from home consumers being very small, whilst on foreign and colonial account the requirements seem to be practically *nil.* Deliveries, as published, show but a small weight of metal passing over local railways, and the shipping and export business may be said to be weak. Owing to the great scarcity of orders makers are a little easier in prices, although no noticeable change has occurred in quotations, 43s. still representing mixed Bessemer samples. The local output does not get larger. There is a slight impetus in the demand for some makes of steel, but on the whole the weight of pig iron used does not represent a large amount. Rails are in but limited demand, at prices which admit of little profit being realised. Special and merchant samples of steel are in brisker inquiry.

Manufacturers of wire and hoops are in receipt of more satisfactory specifications. Iron ore is quiet, and orders are booked at prices ranging from 8s. 6d. to 9s. 6d. per ton net at mines. Large banks of ore are held in stock, and they are not decreasing. A slight impetus has been imparted to the shipbuilding of the district owing to the receipt of several good orders. Engineers, boiler-makers and ironfounders are, on the whole, but indifferently employed. Coal trade is improving slowly so far as the demand for house coal is concerned, but the demand for steam qualities is not so brisk. Prices are unchanged. Shipping dull.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

AT the Cleveland iron market held at Middlesbrough on Tuesday last, the price of pig iron was somewhat firmer than it has been for some weeks. It is not unlikely that sellers will be able to hold their own as long as shipments continue at the present rate. Merchants have sold a certain quantity of No. 3 g.m.b., at 36s. 3d. per ton, but they will not now accept less than 36s. 4½d. The principal makers adhere to 37s., and at that price do a certain amount of business, principally with foreign customers. Makers who are not in the combination are accepting the same price as merchants. No. 4 foundry iron is 34s. 6d. per ton, and grey forge 33s. 9d. to 34s.; but the demand for these grades is very slack.

The prices obtainable for warrants are lower than holders will accept. The price generally quoted is 36s. per ton.

Messrs. Connal's stock of Cleveland pig iron decreased 293 tons last week. The quantities in stock on Monday were 55,525 tons at Middlesbrough, and 584,687 tons at Glasgow.

Shipments of pig iron from the Tees are better this month than they have been since June. The quantity sent away to Monday last was 46,044 tons, as compared with 39,555 tons shipped in the corresponding portion of August.

The manufactured iron trade remains quiet and gloomy, and the mills are working very irregularly. Messrs. Jones Brothers, of Middlesbrough, closed their works on Saturday last until further notice; and Dorman, Long, and Co. have again laid idle the twenty extra puddling furnaces which they started a fortnight ago. Some of the rail mills at the Eston Steel Works were set to work on Monday last, giving employment to about 1000 men. There are still many workmen idle, and distress widely prevails. The prices of finished iron remain unchanged: Ship-plates are £5 per ton; angles, £4 15s.; and common bars, £5 2s. 6d., all on trucks at makers' works, cash 10th less 2½ per cent. Puddled bars are £3 5s. per ton.

Owing to the continued depression, the whole of the men and boys employed at the Michael Pit, Byers Green—about 260 in number—and at the Bank Foot Colliery, Annfield Plain, have received notice to leave. About fifty miners employed at Oakley Pit, West Stanley, have been similarly served.

Messrs. Palmer's Shipbuilding and Iron Company has received an order from the Admiralty for two despatch boats, each with a displacement of 1400 tons, and engines of 2000-horse power. The directors' report on the past year's working shows that a profit of £126,938 was made. It is proposed to pay a dividend of three per cent., making, with the interim dividend paid in March, a total of six per cent. An addition of £30,000 is to be made to the reserve fund, and £25,000 will be set aside for extensions.

There are some slight signs of a revival of the iron shipbuilding industry in the North. Freights are somewhat better. This is said to be caused by the quarantine regulations now in force at many foreign ports. Of course, if ships are compelled to spend a week or two in idleness between the time of arriving at their port of destination and being allowed to commence loading or discharging, it means dearer transit, and freights must rise to cover the extra cost. So far, however, the shipowner could get no benefit. But inasmuch as more ships would be needed under such conditions to do a given traffic, freights must still further advance to induce owners to engage in it. It is said that many owners are now of opinion that materials and labour are at the lowest point they are likely to reach, and that therefore it is a good time to build. Certainly they are at the lowest level they have ever touched in recent years, and manufacturers of iron are making no profit. Shipbuilders declare that they are also prepared to work for nothing. Therefore owners who have the requisite means and courage to build now will probably come well out of their ventures in the long run. The preference for sailing ships as compared with steamers is still very marked, this class of shipping property having latterly been decidedly the more remunerative of the two.

The small ironfounders who have hitherto been so numerously located throughout the mining and manufacturing districts of the North are having an extremely hard time of it. This arises from two exceptional causes, which operate quite apart from the general stagnation of trade. The first cause is the maintenance, by means of the smelters' ring, of the price of foundry No. 3 iron above its real market value. Compared with forge iron, and other grades not within the cognisance of the ring, No. 3 ought to be 2s. per ton lower than it is. Castings are not being kept up in value by any combination; and so the ironfounders are unable to recover from the smelters what they have had to allow to their customers. The second special disadvantage they are under is the gradual growth in favour of steel castings. Wherever strength and trustworthiness and needed steel castings are slowly, but surely, ousting iron ones. The number of steel foundries is also rapidly increasing, and the consequent competition brings daily lower and lower prices. Many ironfounders would fain make steel castings also, if they could. But the plant and process are so different that there seems little general prospect of substitution. The new process must be taken up as an addition, if at all, and the old may be discontinued or not, according to circumstances. But the ironfounders say that this cruel necessity comes upon them after so many lean years that they are not in a position to encounter it.

The sudden and almost tragic termination of the promising career of Mr. W. R. Browne has created a profound sensation in the North, where he was so well known and so highly respected. The regret with which the news has been received is in the minds of many deepened by the thought of the troublous time he latterly had as secretary of the Institution of Mechanical Engineers. His spirited speech when he announced his resignation will not soon be forgotten. He found it necessary to remind some members—happily not many—that when the position of paid secretary to a technical institution is assumed, the attributes and rights of a gentleman are not thereby necessarily abandoned. Mr. Browne may have had his faults, like other men; but, take him all round, he was an able, highly-cultivated, and honourable man; and it is the opinion of many that the attitude towards him of some who ought to have helped him was at least inconsiderate.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*

THE whole of the colliers employed in the Parkgate and Silkstone seams at the Barrow collieries, near Barnsley, have given fourteen days' notice to leave, their action arising out of the dispute in working the Thorncliffe seam, to which reference has already been made. The company desired only to work the south side, and to put two colliers into the place which one man had worked in previously. About 1000 men and lads are affected.

From the Barnsley and Erewash Valley districts the report is that the demand for house coal had been somewhat improved by the cooler weather. In the Barnsley and Sheffield pits less coal has been got out in consequence of Doncaster races. Colliers, as a class, are regular frequenters of the turf hereabouts, and there is scarcely a man of them who does not strain every nerve to see the Leger run. A rather heavy falling-off is reported in the steam coal trade as compared with last year. The total quantity sent last month from the Yorkshire collieries to Hull was only 118,064 tons, being a decrease of over 25,000 tons when compared with last year. Of this decrease, 10,000 tons arise at twelve South Yorkshire collieries. In the Erewash Valley the Woollerton Colliery during August sent 2104 tons of hard coal to Hull, this being, it is stated, their first transaction with that port. Bestwood Colliery sent 2000 tons to Hull during the month. A heavy tonnage of coal is being sent to Grimsby from the Notts pits adjoining Sheffield on the Manchester, Sheffield, and Lincolnshire Railway. This coal, which is used for steamship and engine purposes generally, is mainly for the Continent. While I write there is a return of the warm weather; but the autumn months are certain to "firm" the demand for house coal, as winter stocking will swallow up the surplus.

The Miners' Permanent Relief Fund, to which I referred at some length a week or two ago, is now to be worked under the new scheme, which has been carried by 37 votes to 20. The aged and infirm members' department and the relief fund are now separate departments, the membership of the first being now entirely optional. The benefits from the department are only applicable to members in respect of total incapacity for work after attaining sixty years of age. It is feared that the members who are averse to the alteration will express their aversion by withdrawing from the society, which has now a membership of 16,138.

A foreign correspondent, writing to a local paper, gave some details of the working agreement of the steel rail ring which, on being first mentioned in THE ENGINEER, was received with doubt. A "Congress of English, German, and Belgian rail-makers is now sitting at Bonn and Godesberg-on-the-Rhine, to consider the basis of their agreement, and how it has operated up to now." It seems that the rail-makers of England—not all of them, however—Germany, and Belgium have come to a provisional understanding that for continental orders the contracts are to be divided in the ratio of 60 per cent. for England, 32 per cent. for Germany, and 8 per cent. for Belgium. The weak point is that France and Austria have not joined the conference. The great object aimed at is to determine a uniform price for steel rails intended for the European market, and this can only be done, of course, if all the principal English and continental manufacturers combine in the convention. France and Austria must not only be included in that portion of the convention which refers to transmarine export, but in all others parts of it, so as to secure a common basis for all countries.

Much dissatisfaction is quietly expressed here at the action of the authorities in their efforts to manufacture large steel castings at Woolwich. It is argued that Woolwich, being so far distant from the iron ore and the coal, is not a favourable place for the manufacture of such articles, and that the work is already being done by local firms, who have laid down costly plant for the purpose, and devoted great attention to the special requirements of the Government. It is not believed that the Woolwich authorities can manufacture on equally favourable terms with private firms. Some time ago it was announced with a flourish of trumpets that the Woolwich authorities had abandoned their intention of manufacturing their own castings; but that announcement seems to have been premature.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

SOME little interest has been felt in a discussion which is going on in the West of Scotland just now with reference to the moral obligation of landowners to grant an abatement of the royalties and other charges payable by mineral tenants. It is contended, on the one hand, that as prices of coal and iron, especially the latter, are so low that these industries cannot be remunerative, the superiors ought, in justice, to reduce the royalties; while, on the other, doubts are expressed as to whether the pig iron industry is being actually carried on at a loss, and the question is asked—if landlords afford a measure of relief to their tenants now, will the latter recognise the principle of increasing the landlords' dues on the recurrence of extra prosperous times? The question appears to be one which it is not possible to deal with in a general sense, and there is not much chance of any practical result coming out of its discussion in the meantime.

The iron market has been strong this week, in consequence of the good demand for makers' special brands, the quotations of which show a very decided increase upon those of last week. The week's shipments of pig iron were 13,167 tons, against 10,311 in the corresponding week of 1883. By the blowing-out of a furnace at Summerlee the number in blast is reduced to 94, as against 115 at the same date last year. The stock of pig iron in Messrs. Connal and Co.'s stores is reduced by 400 tons since last report.

Business was done in the warrant market on Friday at 41s. 7½d. cash, and on Monday at 41s. 8d., while on Tuesday a further advance occurred to 41s. 10d. Business was done on Wednesday at 41s. 8½d. cash, and 41s. 10½d. one month. To-day—Thursday—the market was strong, with transactions at 41s. 9d. to 41s. 10½d. cash, and 42s. 0½d. one month.

The values of makers' iron are now as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 55s.; No. 3, 50s. 6d.; Coltness, 60s. 6d. and 52s.; Langloan, 57s. and 52s. 6d.; Summerlee, 53s. and 47s. 3d.; Calder, 53s. and 47s. 6d.; Carnbroe, 50s. 6d. and 47s.; Clyde, 48s. 6d. and 45s.; Monkland, 43s. 6d. and 40s. 6d.; Quarter, 42s. and 40s. 3d.; Govan, at Broomielaw, 43s. and 40s. 9d.; Shotts, at Leith, 52s. 6d. and 51s. 6d.; Carron, at Grangemouth, 48s. (specially selected, 52s. 6d.), and 47s. 6d.; Kinneil, at Bo'ness, 43s. 6d. and 43s.; Glengarnock, at Ardrossan, 50s. and 43s.; Eglinton, 44s. 6d. and 41s.; Dalmellington, 47s. 6d. and 43s. 6d.

In the malleable iron trade there is nothing of importance to notice this week. General engineers have a fair measure of employment, but marine shops are very slack. The ironmongery trade is in a moderately active state, there being good sales for the supply of country retailers at present. The nail trade is undergoing some change in consequence of the extension of competition, and the values of steel nails are being run down until they are now very little above the price of iron nails.

The past week's shipments of iron manufactures from Glasgow included locomotives to the value of £11,221; machinery, £2200; sewing machines, £820; steel goods, £4200; and iron manufactures, £45,560.

The shipping department of the coal trade is less active, and in some districts the quotations are weaker in consequence. At Ayr the week's shipments of coals were 9301 tons; Troon, 8368; Grangemouth, 8850; and Irvine, 2805 tons. The advent of colder weather will, of course, help the inland consumption; but the trade as a whole is duller at present than for a considerable time back.

From what transpired at a conference of miners a few days ago at Hamilton, it appears that the leaders of the men have not yet abandoned the idea of inducing the masters to advance wages. At these conferences there is generally a remarkable want of information as to the exact position of trade, and so the men are led to expend much useless effort, which they might have saved if they had better informed leaders. The Executive Board of the Fife and Clackmannan Miners' Association met at Dunfermline on Saturday—Mr. James Innes in the chair—when the secretary, Mr. Weir, reported that he had visited all the collieries, and the unanimous feeling of the men was that a sliding scale ought to be based upon the prices ruling between November and February last. He also intimated that he had renewed the former demand for an advance of 15 per cent. in their wages, but the employers had not sent any acknowledgment of his letter.

In a former letter I gave the chief points of the report of the Shotts Iron Company, which has since been adopted at a meeting of the shareholders. Mr. John Walker, the chairman, stated at that meeting that there was no indication of a revival of trade. They had been able, however, to maintain the works in a state of full efficiency, and the Shotts furnaces were now capable of producing more pig iron than at any former time. He also intimated that negotiations had been completed which would ensure a good supply of first-class blackband ironstone for a very long term of years, and when an improvement occurred, the company would be in a position to take full advantage of it.

Mr. A. Fraser, secretary to the Pumpherston Oil Company, has, by instruction of the directors, issued a circular to the shareholders, in which he intimates that the erection of the works is now practically completed, and that within a few days they will be fully at work.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE *Times* is my authority for the statement that the Barry Dock and railways are estimated to cost £1,600,030.

Amongst the railway links now being forged are the Cardigan extensions—the Whitland and Cardigan railway. Whitland, which is the joint on the Great Western Railway in South Wales linking Tenby and Pembroke dock, will thus bring Cardigan into the field of civilisation. Though an ancient city and port, it is now only accessible by coach. The same may be said of Fishguard, and of Newport, Pembrokeshire, a bay so attractive that it is much resorted to from long distances, though the only conveyance is a carrier's wagon, or lumbering coach.

I am glad to hear that steps are being taken to revive the first projected line from Risca to Cardiff. This was abandoned in favour of another scheme which aimed to avoid opposition, but being allowed to fall through, the original projectors are taking up the former one. If a very good area of coal and easy gradients are attractive, this should be.

The slight decline I have recorded as taking place in the South Wales coalfield is well shown by the statistics of the leading railways apart from the Taff Vale. These show that in the first eight months of 1883, 4,510,955 tons were carried, but in 1884, 4,374,545 tons. Midland, London and North-Western, all showed a decrease. The decrease in coal to London for the year so far is 137,419 tons. During the last week there has been a better tone, and shipments have increased, Cardiff sending away 151,781 tons, or 9000 tons more than the previous week, while Newport records a few hundred tons in excess. As regards Swansea, the average is well maintained. During the week 109 vessels—sailers and steamers—came in, and the Harbour Trust reports that the returns for August are more satisfactory than for any previous month in the year.

I hear that the Tyla Coch Colliery will be floated by a company, limited. A considerable addition has been made to the coal acreage by the discovery of the Aberghartin vein. A new coal-field has been opened in the Dulais Valley. Mr. Thomas, of Quay Parade, Swansea, has been successful in striking coal, and with an area of 320 acres the prospects are good.

The tin-plate trade is not so buoyant, and in some quarters the dearth of new orders has told rather heavily. Fortunately, Swansea is fairly off for contracts, and, as prices are drooping, they are not willing to book fresh trade at the 3d. or 6d. decline per box which has set in.

As an indication of the briskness which has been experienced in the past, I note that 3000 tons of tin-plates were shipped from the Prince of Wales Docks, Swansea, during the week to the United States. During the month of August 141,253 boxes were sent to New York, 11,418 tons to Philadelphia, 15,226 to Baltimore, and 5434 tons to Montreal. Future prospects are not so good, and buyers are forcing ordinary cokes down to 15s.

With reference to the disposal of Coedcae Colliery to Mr. Radford, noticed in last week's ENGINEER, the arbitration held at Cardiff was in respect of the price to be paid for the coal to Messrs. Lewis and Co., not for the colliery. I regret giving publicity to a local error.

I have no improvement to record in the steel works. Some soreness has been caused in the district by the announcemen that a Government contract for 80,000 tons of rails has gone into Germany.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, Sept. 10th.

THE very low prices to which iron and steel have declined in the American markets have brought within a few days an improvement in demand, which is certainly gratifying to manufacturers and brokers, who have been waiting for months for a favourable turn.

The Phœnix Bridge Company, of Philadelphia, have agreed to build the King's Country Elevated Road in Brooklyn, which will be fourteen miles long, and cost 10,000,000 dols. Several companies—home and foreign—bid upon this work, but the Phœnix people made the best propositions, and carried off the prize. They will take their payments in bonds, which they can negotiate at small discount. This enterprise has been on foot for about three years.

There have been sales of nearly 100,000 tons of steel rails within a week or two at prices ranging from 26 dols. to 27 dols. at mill in Pennsylvania, and it is understood to-day that there are a good many additional contracts to be placed. The Baltimore and Ohio Company are in the market for 10,000 tons of plate and bridge iron, and 10,000 tons of steel rails, and other companies are in the market for large stocks, all of which has the effect of improving demand, if not prices.

The locomotive works are not increasing their orders yet, but all the repairing shops are very busy. This spirit of economy will continue until flush times. The railroads are showing good earnings. The volume of traffic is heavy, but there are rumours of a break in the pool arrangements, though in reality there is very little probability of any such event.

The markets generally are in a somewhat better condition than last week. Corn and wheat are moving a little more freely. The farmers are unable to hold any longer owing to lack of storage capacity, and their shipments are increasing traffics, and leading to a slight decline in tidewater prices, owing to a lack of demand for export.

A cashier and president of a New Jersey State bank has committed suicide in consequence of the discovery of extensive embezzlements of funds and securities committed to their charge. A good many bank failures have taken place, but in all cases they are due to exceptional causes, such as private speculation and the like. Great interest is being manifested in political circles. Both Republicans and Democrats are making as good a fight as they can without money, and the vote will be very close. The election of Cleveland means a reduction of tariff duties, while the election of Blaine means a very slight modification, and an adherence to the tariff policy.

Several very valuable railway properties which are temporarily embarrassed are making vigorous efforts to reorganise on a new basis, by which they will be enabled to have payments deferred which they are not in a position to meet at present. There are about 10,000 miles of American railways that are in a shaky condition; and in many cases new presidents and managers have been elected for the purpose of bringing order out of contusion, and for the purpose of placing these badly managed properties upon a solid basis.

The talk of a blast furnace restriction has about died out. The scheme will fail. There are not three weeks' stocks of iron in the United States. Even large consumers have only a few days' supply. Millowners are carrying stocks from week to week. Several important engineering enterprises are proposed.

The International Electrical Exposition has been opened, and the scientists from the other side of the water are being entertained. The Exhibition is being attended by tens of thousands. It will be a success. A good deal of work yet remains to be done.

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.

9th September, 1884.

12,154. Working, &c., Bottle Necks, H. Agar, London.
12,155. Railway Chairs, &c., J. Quarmby, Manchester.
12,156. Bottle-stoppers, W. and S. Hill, London.
12,157. Locking Screw Bolts, J. Quarmby, Manchester.
12,158. Fire-lighters, W. C. Haigh, Manchester
12,159. Packages for Containing Soda, &c., J. Clare, Warrington,
12,160. Piston Punch, G. Alston, Glasgow.
12,161. Grass-cutting Machines, H. Branch, Wellingborough.
12,162. Haulage Clip for Ropes, S. Morgan, Birmingham.
12 163. Pulling Out Hat Bodies, J. Marshall, Stockport.
12,164. Folding Case, J. G. Branford, Birmingham.
12,165. Stair Rods, J. T. B. Bennett, Birmingham.
12,166. Fixing Candles in Sockets, W. Whiston, Birmingham.
12,167. Utilising Water in Motion, R. Baynes, Liscard.
12,168. Washing Machine, J. Carter, Manchester.
12,169. Manifold Copying Books, W. Wrightson, Barnsley.
12,170. Neutralising Effects of Collisions, A. I. Rath, Manchester.
12,171. Metallic Bedsteads, W. P. Hoskins, Birmingham.
12,172. Gas Furnaces, D. Clerk, Glasgow.
12,173. Saddles for Bicycles, W. P. Thompson.—(*W. S Kelley, U.S.*)
12,174. Making Salts of Ammonia, W. Arrol and J. Meikle, Glasgow.
12,175. Reversible Levels, C. F. and T. Cooke, Bishophill, York.
12,176. Securing Railway Rails to Chairs, M. Stevens, Bath, and F. W. Stevens, Bombay.—*6th February*, 1884.
12,177. "Fret" Cloth W. Fielding, London.
12,178. Wheel, W. Naylor, Birmingham.
12,179. Barbed Fencing, F. W. Brampton, Birmingham.
12,180. Brake-handle, C. Dutton, Birmingham.
12,181. Preventing the Slamming of Doors, W. Bahre, London.
12,182. Purifying Iron, J. E. Atwood. London.
12,183. Sewing Machines, H. J. Allison.—(*Wheeler and Wilson Manufacturing Company, Incorporated, U.S.*)
12,184. Automatic Regulators, J. Bowie, London.
12,185. Moulds for Castings, R. W. Traylor, London.
12,186. Cerealine, J. F. Gent, London.
12,187. Removing Cotton Fibre from Cotton Seed, R. Meldola and W. H. Stead, London.
12,188. Flooring Clamp, R. and R. W. Booth, Dublin.
12,189. Steam Boilers, C. A. Knight, London.
12,190. Elevators, T. Clark, London.
12,191. Locomotive Engines, J. D. Larsen, London.
12,192. Closed Water-waste Preventing Cistern, S. A. and P. G. Hugh, London.
12,193. Preparing Sulphate of Lime, C. W. Knowles, London.
12,194. Portable Candle-holder, H. J. Haddan.—(*R. Lange, Rudolstadt.*)
12,195. Safety Needle, H. Lüttringhaus, Barmen, Germany.
12,196. Driving Gear of Machines, G. Wilkinson, London.
12,197. School Seats, E. B. Andrews, London.
12,198. Axles of Wheels, G. Littlewood, London.
12,199. Watch Movements, R. Squire, London.
12,200. Portable Ranges and Stoves, &c , T. J. Constantine, London.
12,201. Gas Engines, F. G. Griffith, London.
12,202. Moulding Artificial Fuel, E. F. Loiseau, London.
12,203. Permanent Way of Railways, W. R. Rowan, London.
12,204. Rope Traction Tramways, W. R. Rowan, London.
12,205. Crate Pack Saddle, J. E. P. Mosley, London.
12,206. Automatic Registering Ticket Punch, R. W. Thomas and P. C. Smith, London.
12,207. Conduits for Cable Railways, H. H. Lake.—(*G. Rice, U.S.*)
12 208. Scraping Gravel Walks, J. le Patourel and T. le Poidevin, London.
12,209. Velocipedes, J. A. Score, London.
12,210. Combination of Games, V. Hess.—(*I. Neumann, Vienna.*)
12,211. Tricycles, T. P. and J. B. Hall, Toronto.
12,212. Fire-escapes, T. P. Hall, Toronto.
12,213. Rock-boring Apparatus, G. Pitt.—(*F. B. Taylor, U.S., and J. Hanning, Paris.*)
12,214. Supports for Shades for Lamps, &c., L. Gye, London.
12,215. Electric Telegraphs, F. H. W. Higgins, London.
12,216. Knitting Machinery, A. Paget, London.
12,217. Self-closing Valves, &c., E. T. Lambert and E. J. White, London.
12,218. Utilisation of Electric Force, J. S. Williams, London.
12,219. Converting Manual Force into Electric Force, J. S. Williams, London.

10th September, 1884.

12,220. Winches, D. W. Porteous, Paisley.
12,221. Gas Producers, J. W. Snowdon, T. May, and R. M. McDowall, Leeds.
12,222. Velocipede, H. Edwards, Manchester.
12,223. Puddling and Mill Furnaces, B. Leek, Stoke-on-Trent.
12,224. Tanks for Storing Oil, W. Walker, Liverpool.
12,225. Curtain Chain, W. Foxcroft, Birmingham.
12,226. Compressing Ensilage, J. T. Moore, Crewe.
12,227. Pentagraphs, J. J. Rugg, Birmingham.
12,228. Cutting the Pile of Woven Fabrics, J. Newhouse and J. Sampson, Manchester.
12 229. Baling Presses, &c., G. Lewis.—(*T. Drewett, Bombay.*)
12,230. Presses for Baling Cotton, &c., W. N. Dack, Manchester.
12,231. Cut Nails, T. E. Mansfield, Bedminster.
12,232. Wrench or Spanner, J. E. Gyde and G. H. Brydges, Birmingham.
12,233. Railway Vehicles, R. Hill and J. Darling, Glasgow.
12,234. Cushioning and Absorbing Shocks in Railway Trains during Collision, R. Hill and J. Darling, Glasgow.
12,235. Vice, W. Corteen, London.
12,236. Fastener or Catch, C. G. E. Terraneau, London.
12,237. Lift, J. Bartlett, London.
12,238. Releasing Runaway Horses from Carriages, C. Tomlinson, London.
12,239. Millboard, &c., Machines, S. H. Hodges, London.
12,240. Bodies of Bassinette Perambulators, J. T. Shaw, London.
12,241. Studs, A. Guillaume, Birmingham.
12,242. Leather Picking Arms for Looms, R. D. Harrison and W. Scholfield, London.
12,243. Spring Attachments for Jewellery, &c., J. Lamb, London.
12,244. Shampooing, J. W. Butcher and A. G. Klugh, London.
12,245. Brushing Floors, A. J. Boult, London.
12,246. Asphalt Pavement, F. Wilkins, London.
12,247. Tram Engines, S. Feather and R. Shackleton, London.
12,248. Dyeing, D. Hepworth, London.
12,249. Circular Combing Machines, A. Smith, London.
12,250. Coating Wire, J. H. Roberts, London.
12,251. Sheaf-binding and Trussing Machines, J. Howard and E. T. Bousfield, London.
12,252. Carding Engines, R. F. Barker, London.
12,253. Generators of Steam, W. Schmidt, London.
12,254. Gas Lamps, T. C. J. Thomas, London.
12,255. Valve Gear for Steam Engine, J. A. Norberg, London.
12,256. Purifying Water, W. Anderson, London.
12,257. Window Blind Material, J. Partridge, London.
12,258. Sorting Wool, W. Rigg, London.
12,259. Hats, J. Eaton, London.
12,260. Stoppering Mouths of Bottles, &c., W. E. C. Spencer, London.
12,261. Breaking Wheat, &c., C. Lampitt and E. J. Guest, London.
12,262. Making Iron, &c., S. P. Wilding.—(*H. W. Kasten and S. Hein, Hanover.*)
12,263. Motive-power for Velocipedes, J. Whittingham, London.
12,264. Gas Engines, A. Davy, London.

11th September, 1884.

12,265. Ships' Rudders, E. G. Camp, Bristol.
12,266. Extensive System of Outdoor Games, A. S. King, Norwich.
12,267. Pickers, R. Bury, Halifax.
12,268. Fastenings for Busks of Stays, &c., F. R. Baker, Birmingham.
12,269. Cravats, &c., F. R. Baker, Birmingham.
12,270. Automatic Propeller for Tramcars, &c., J. Shaw, T. Harrison, and W. Shaw, Bradford.
12,271. Belt Stretcher, G. J. Booth, Manchester.
12,272. Flushing Water-closets, &c., J. H. Kenyon, Manchester.
12,273. Carding Engines, W. Dobson, London.
12,274, Differential Gearing for Velocipedes, G. T. Burden, Birmingham
12,275. Fire-extinguishing Apparatus, W. Lees, Ashton-under-Lyne.
12,276. Automatic Brakes, H. Brockelbank, London.
12,277. Steering Head of Tricycles, R. J. Russell, London.
12,278. Roof and other Lamps, R. Thorley, London.
12,279. Steering Agricultural Implements, R. Bawden, South Molton.
12,280. Coating Metallic Surfaces, A. Parkes, London.
12,281. Treating Surfaces of Glaciara, W. W. Nightingale, London.
12,282. Pumping Beer, &c., from Casks, T. W. G. Hewitt, Great Grimsby.
12,283. Dredging Machine, The Golden State and Miners' Ironworks, H. B. Angell, T. H. Williams, D. Bixler, U.S.
12,284. Rotary Engines, G. T. Leitch, Glasgow.
12,285. Killing Whales, &c., W. A. Hay, Glasgow.
12,286. Retorts for Distilling Shale, &c., P. Dow, Glasgow.
12,287. Filters, E. M. Knight, Halifax.
12,288. Conveying Ships over Land, G. W. Harris and W. Dawes, Leeds.
12,289. Cartridge Presses, A. Attwood, Lancashire.
12,290. Water-closets, W. H. Hindle, Halifax.
12,291. Portable Hand Bolt, J. E. Walsh.—(*Francois Lebacq, Brussels.*)
12,292. Manufacture of Explosives, E. Luck and F. B. W. Roberts, London.
12,293. Governors for Gas Engines, C. W. Pinkney, London.
12,294. Boots, J. Bridge, London.
12,295. Spring Mattresses, W. T. Smith, Birmingham.
12,296. Scissors, C. Ohliger, London.
12,297. Strong Rooms, S. Chatwood, London.
12,298. Compensating Spring Motor, D. O. Genteur, London.
12,299. Jointing Pipes, C. Wall, London.
12,300. Electric Locomotive, J. C. Mewburn.—(*M. Deprez and M. Leblanc, Paris.*)
12,301. Opening and Closing Doors of Hansom Cabs, J. Saxby, jun., London.
12,302. Ventilating Hats, H. C Zerffi, London.
12,303. Droppers for Wire Fencing, W. Forsaith, South Africa.
12,304. Varying the Speed of Tricycles, W. Cross, London.
12,305. Securing the Cross Threads in Knitting Machines, J. Poole, London.
12,306. Boots, J. Box, London.
12,307. Manufacture of Sugar from Seaweed, F. M. Lyte, London.

12th September, 1884.

12,308. Hoists, J. Swalwell, London, and J. Moore, South Stockton-on-Tees.
12,309. Sheave Pulley Blocks, J. Swalwell, London, and J. Moore, South Stockton-on-Tees.
12,310. Driving for Printing Machine Counters, W. Cuthbertson, Manchester.
12,311. Valves, A. Bradshaw, Accrington.
12,312. Gas Engines, J. Brine, London.
12,313. Steam Heating Apparatus, R. D. Early, Dawlish.
12,314. Stopping Vehicles, &c., A. Reckenzaun, London.
12,315. Tube India-rubber Pencil, &c., T. Rosethorn, Manchester.
12,316. Brakes, D. P. McNiven, London.
12,317. Complex Ores or Solutions, G. I. J. Wells, Liverpool.
12,318. Gas Motor Engines, J. Dougill, Oldham.
12,319. Drill Braces, G. R. Postlethwaite, Birmingham.
12,320. Boxes, W. J. Bentley, London.
12,321. Regulating the Supply of Gas, W. W. Cox, Torquay.
12,322. Note Pedals for Musical Instruments, W. Dawes, Leeds.
12,323. Washing and Cleansing Casks, G. Inskipp and J. Mackenzie, London.
12,324. Applying Dandy Score Sheaves to Fishing Smacks, W. Sissons and P. P. White, London.
12,325. Preparing Tea, S. F. Smith, London.
12,326. Gloss Starch, W. T. H. Carman.—(*W. Zwick, Neumühle-Alberswеiler.*)
12,327. Rails and Fish Joints, F. Barnes, London.
12,328. Warve for Spinning, &c., Frames, S. Rowbottom, London.
12,329. Stereoscopes, J. Lyons, London.
12,330. Staiths, &c., S. Butler, London.
12,331. Deck Seat, R. Rose, London.
12,332. Hat and Coat Rail, M. O. Hund.—(*Gretschel and Heineman, Reudnitz.*)
12,333. Breech-loading Ordnance, J. Vavasseur, London.—*6th August*, 1884.
12,334. Breech-loading Ordnance, J. Vavasseur, London.—*6th August*, 1883.
12,335. Corking Bottles, D. Bryce and W. Bowley, London.
12,336. Pneumatic Cannon, W. A. Bartlett, London.—*4th March*, 1884.
12,337. Pneumatic Cannon, W. A. Bartlett, London.—*4th March*, 1884.
12,338. Pneumatic Cannon, W. A. Bartlett, London.—*4th March*, 1884.
12,339. Centrifugal Reels, W. H. Dickey, London.
12,340. Coke Ovens, H. Simon, London.
12,341. Cutting and Drilling Tubes, J. C. Merryweather and C. J. W. Jakeman, Greenwich.
12,342. Shutting Mechanism for Receptacles with Circular Openings, M. Mechnig, London.
12,343. Bootjacks, A. Gehrig-Liechti, London.
12,344. Boots and Shoes, W. Stevens, London.
12,345. Purifying, &c., Apparatus, S. D. Cox, London.
12,346. Paper-pulp, W. R. Lake.—(*C. S. Wheelwright and G. E. Marshall, United States.*)
12,347. Boring, &c., Pipe Fittings, F. Grinnell, Providence, U.S.
12,348. Brakes for Railway Trains, &c., E. J. C. Welch, London.
12,349. Neckties, &c., G. M. Braggiotti, London.
12,350. Secondary Batteries, D. G. FitzGerald, London.
12,351. Buckles for Belts, &c., J. A. Malezon, London.
12,382. Mounts for Tobacco-pipes, &c., W. Hewitt, London.
12,353. Tricycle, W. J. R. Elgy, London.

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12,354. Rotary Engines, &c., C. Smith, Glasgow.
12,355. Square Driving Belts, &c., F. Fleming, Halifax.
12,356. Closets and Commodes, C. Cowney, Birmingham.
12,357. Inserting Items of News in Stereotype Plates, W. Curthoys, Wolverhampton.
12,358. Ruling Paper, G. Davies, Birmingham.
12,359. Trusses for the Cure of Hernia, J. S. Burgess Manchester.
12,360. Harpoon Guns and Harpoons, &c., R. Low, Glasgow.
12,361. Brake, T. G. Beckett, London.
12,362. Screw Vent Pin, H. Agar, London.
12,363. Brooms and Brushes, T. H. Mason, London.
12,364. Planing Machines, J. Rawlings, London.
12,365. Boiling and Setting Woven Fabrics, I. H. and T. Bottomley, London.
12,366. Constructing Woven Fabrics, R. Arthur, Jarrow-on-Tyne.
12,367. Double-acting Safety Brake for Vehicles, J. B. Jepson, Chatham.
12,368. Hoists for Raising Materials, J. Tottenham, Wood Green.
12,369. Moulding Articles of Metal, C. Cousins.—(*G. T. Hyde, U.S.*)
12,370. Glass Bevelling Machinery, E. C. Urry, Holloway, and H. Rayner, Glasgow.
12,371. Jet Apparatus for Fire Extinction, &c., F. Bolton, London.
12,372. Colouring Paper in Endless Rolls, W. H. Beck.—(*L. Piette, Pilsen.*)
12,373. Bicycles and Tricycles, J. W. Couchman, London.
12,374. Electric Generator, C. Baudet, London.
12,375. Stretching, Dressing, &c., Lace, L. Lindley, London.
12,376. Stirrups, C. K. Gibbons, London.
12,377. Air Springs or Buffers, W. de Wagstaffe, London.
12,378. Ships' Propellers, J. N. Söderholm, London.
12,379. Utilising Waste Heat from Coke Ovens, C. Kingsford, London.
12,380. Printing Metallic Deposits upon Ivory, E. Nienstaedt, Berlin.
12,381. Gas Producer Furnaces, &c., A. Fullarton, London.
12,382. Reflectors, H. Boehle, London.
12,383. Glass Roofing, J. Sewell, London.
12,384. Backs for Argand Reflector Lamps, W, Ramsey, London.
12,385. Bleaching Waste Paper, W. Clark.—(*E. A. D. Guichard, Paris.*)
12,386. Reducing Loss to Coins by Wear, W. R. Finch, London.
12,387. Compensating Apparatus for Railway Points, &c., H. Williams, Glasgow.
12,388. Button-hole Weaving, J. Kenny, London.

15th September, 1884.

12,389. Folding Cameras, J. T. Chapman and T. Scott, Manchester.
12,390. Railway Chairs, J. Steen and B. P. Walker, Wolverhampton.
12,391. Sharpeners for Horseshoes, A. Sutton, Halifax.
12,392. Railway Trucks, R. Wilson and J. Cunliffe, Manchester.
12,393. Plates for Packages, W. Powell, Liverpool.
12,394. Weavers' Pirn-board Pins, W. and C. Crawford, Glasgow.
12,395. Raising, &c., Household Articles, W. A. Hunter, Liverpool.
12,396. Card, Sheet, or Book, J. Entwistle, Manchester.
12,397. Stop Motions for Slubbing, &c., Frames, W. Taylor, Manchester.
12,398. Suspenders for Trousers, J. and A. Smethurst, Manchester.
12,399. Looms, M. Shuttleworth and W. Hacking, London.
12,400. Securing Neckties, J. P. Williams, London.
12,401. Fastenings for Corsets, G. Wrencher, London.
12,402. Doubling, &c., Yarns, H. Sands and A. S. Brindley, London.
12,403. Looms for Weaving Fabrics, J. Wade, London.
12,404. Moving Furniture, M. Haymans, London.
12,405. Sewer and Drain Pipe, H. S. Cregeen and E. J. Thomas, Bromley, Kent.
12,406. Steam Engines, K. L. Blanck, Melbourne.
12,407. Making Silk Laces, J. Biedermann, London.
12,408. Treating Saccharine Solutions, C. Lyle and J. J. Eastick, London.
12,409. Purifying Water, C. Lyle and J. J. Eastick, London.
12,410. Concentrating Sulphuric Acid, T. W. B. Mumford and R. Moodie, London.
12,411. Egg-cooker, C. Whitfield, Kettering.
12,412. Lathes, S. P. Wilding.—(*H. Wohlenberg, Hanover.*)
12,413. Threading Glass, W. W. Boulton, London.
12,414. Milling, &c., Rice, &c., T. West, Bromley-by-Bow.
12,415. Steam Engines, W. Evans, London.
12,416. Getting-up Steam in Boilers, A. W. L. Reddie.—(*W. Craig, U.S.*)
12,417, Ladders applicable as Fire-escapes, C. Bellest, London.
12,418. Centrifugal Flour-dressing Machine, F. van den Wyngaert, London.
12,419. Cigar Case, M. Mohr, London.
12,420. Bridge, J. A. Westerman, London.
12,421. Obtaining Hydrochloric Acid Gas, W. L. Wise.—(*Messrs. Solvay and Co., Brussels.*)
12,422. Turning over the Leaves of Music, G. Brockelbank, Anerley.—*20th August*, 1883.
12,423. Steam Boilers, W. Keable, London.
12,424. Hair Pins, F. Savory, Painswick.
12,425. Asphalt, H. Kettmann, London.
12,426. Preparing Metallic Plates for Etching, H. H. Lake.—(*W. Herbert, Australia.*)
12,427. Digesters, T. Routledge, London.
12,428. Treating Ramic Grass, J. Y. Johnson.—(*J. A. Kaulek, Paris.*)
12,429. Forks used by Endless Ropes, W. Hedley, London.
12,430. Electrical Pressure Alarum, J. Lorraine, London.
12,431. Gas Motor Engines, J. J. Purnell, London.
12,432. Coupling a Carriage to a Train, E. R. Prentice, London.
12,433. Pneumatic Hammer, O. Imray.—(*C. A. Arns, Remscheid.*)
12,434. Distemper Brushes, C. A. Watkins and W. L. Sutton, London.
12,435. Tanning Skins, W. Clark.—(*E. Herrmann, Vienna.*)

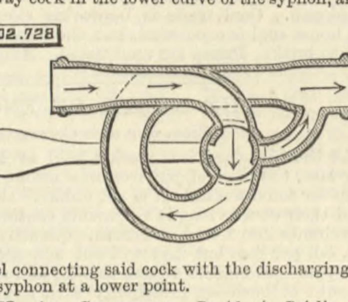
SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

302,728. Waste-pipe Trap, *Thomas C. Hargrave Minneapolis, Minn.—Filed January 25th*, 1884.

Claim.—The combination, with a syphon trap, of a three-way cock in the lower curve of the syphon, and a

302.728



channel connecting said cock with the discharging-leg of the syphon at a lower point.

302,978. Air Compressor, *David A. Brislin, St. Louis, Mo.—Filed August 29th*, 1883.

Claim.—(1) The combination, with the cylinder A, of the piston B, the valves C D, the port F, the chamber E, the piston G, the rod g, tappets g^1 g^2, and cam H, substantially as described. (2) The combina-

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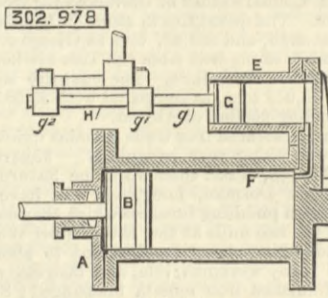

tion, with the cylinder A, of the valves C D, the piston B, the port F, the chamber E, and the piston G, substantially as described.

303,036. Rolling Mill, *Arthur J. Moxham, Louisville, Ky.—Filed November 26th*, 1883.

Claim.—(1) A set of rolls for rolling blooms or piles of rectangular cross section into girder rails or beams, provided with a pass or grooves, having shaping or forming tongues, as A B C therein, and spaces, as at 1 2 3, the absolute volume of space thus provided for the flow of the metal being only equal to or slightly less than the volume of metal displaced under the shaping action of said tongues thereon, whereby the bloom or pile, being entered into said pass with one of its diagonal lines vertical and the other horizontal, is supported by all portions of the pass, twisting of the same being thereby prevented and straight delivery of the metal from the pass secured, all substantially as described, for the purposes set forth. (2) A set of rolls for rolling metal blooms or piles into girder shapes, provided with a dummy pass or grooves having spaces, as at E and D, substantially of the contour indicated in Fig. 2, the desired shape of metal in

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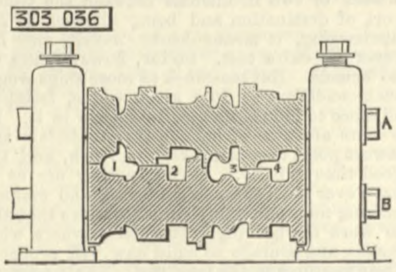

the space E being imparted by elongation, but in the space D mainly by displacement independently of elongation, all substantially as described, for the purposes set forth. (3) A set of rolls for rolling metal blooms or piles, provided with two passes substantially of the conformation indicated in Figs. 1 and 2, for the purposes set forth. (4) A set of rolls for rolling metal blooms or piles, provided with two passes substantially of the conformation indicated in Figs. 3 and 4, for the purposes set forth. (5) A set of rolls for rolling metal blooms or piles, provided with passes substantially of the conformation indicated in Figs. 1, 2, 3, and 4, for the purposes set forth.

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