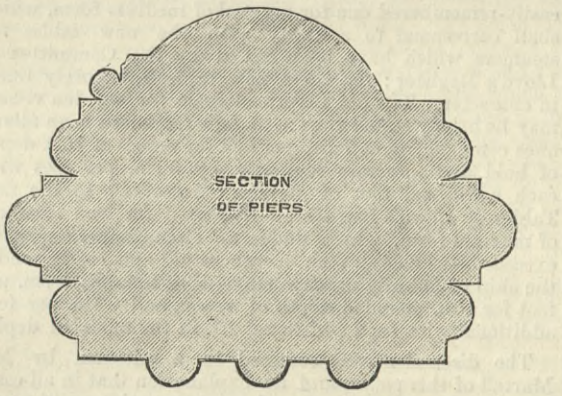
PETERBOROUGH CATHEDRAL.

AFTER a building has stood firmly for about 700 years, it is, perhaps, rather late to complain of the nature of its foundations; but there is, nevertheless, ample reason for saying that the extensive reconstructive work which has become necessary in the cathedral of Peterborough is the result of faulty foundations. It is generally known that the main tower of this cathedral is now in course of reconstruction, or more truly, that preparations are progressing rapidly for taking it down to prevent its falling and causing the destruction of a great part of the whole cathedral. We propose here to give a short account of the nature of the failure which has led to this, our remarks being illustrated by the group of engravings which we give on page 268, which have been prepared from photographs placed at our disposal by Mr. John Thompson, of Peterborough, by whom the work of taking down and reconstruction is being carried out, Mr. J. L. Pearson, R.A., being the architect.

Like most of our oldest monastic establishments, the early recorded history of that in which the Peterborough Cathedral originated, is of very uncertain accuracy. The first monastery is said to have been established about A.D. 655 by Peada, the eldest son of Penda, the fourth king of Mercia. It seems to have been partly or wholly built of stone, and was known as the monastery of Medehamstede. This building was robbed and destroyed by fire by Danes under Hubba in 870. It was rebuilt in 966 under Athelwold, then Bishop of Winchester, but it was again sacked and destroyed by fire by Danes under Hereward the Wake between 1066 and 1069. For some period after this again the monks had a bad time of it at frequent intervals, though the income from the land attached to the establishment was enormous. This enabled them to remain in the locality and gradually rebuild the monastery; but it was again almost wholly destroyed by fire, though it is said accidentally this time, in the year 1116. In 1117 John de Sais, the then abbot, laid the foundation of a new monastery, which was built partly under him and partly under Martin de Vecti, abbot appointed in 1133, who seems to have commenced and finished part of the cathedral, but the part with which we are concerned was originally, it is said, built by William de Waterville, abbot from 1155 to 1175 or 1177, but his successor, named Benedict, seems to have done a great deal, including the painting of the oak ceiling, seen in Figs. 2 and 3. This, it will be remarked, is very like the ceiling of part of the St. Alban's Cathedral. As built by Abbot de Waterville the tower was a lofty structure much higher than that now doomed, but this, it is recorded, proved too heavy for the piers by

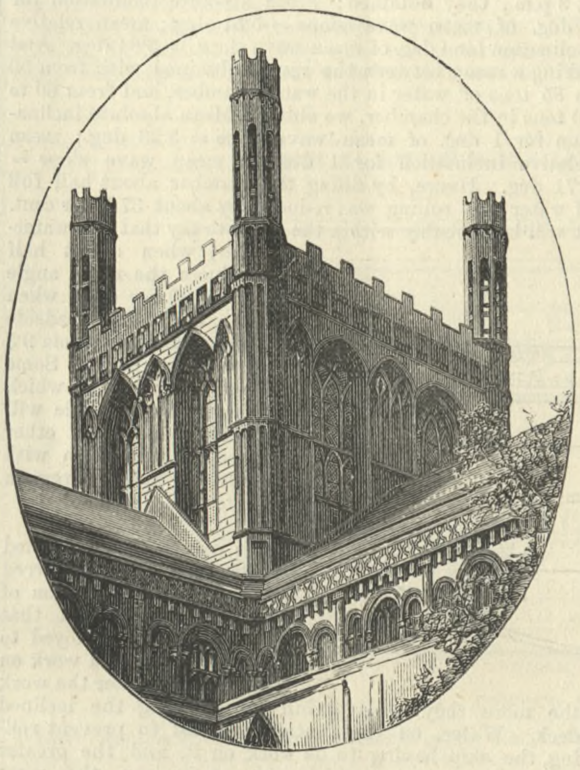
FIG. 10.



which it was supported, and had to be taken down nearly to the crown of the arches which we illustrate. The lantern was rebuilt, in about 1350, of less weight and much less height, and has so remained until now, except that it was surmounted by a wooden structure, which was subsequently removed, making the central tower much less in height than architectural uniformity with the general design would dictate. To remove the somewhat squat appearance of this feature of the building and to add a little to its dignity, Dean Kipling, at the beginning of the present century, had the four corner turrets or pinnacles added, as seen in Fig. 9. For a long time these turrets gained little approval, and were known as "Dean's chimneys." This central tower then had long given much trouble, and the work of different periods is plainly discernible. The north and south arches are fine Norman, while the other arches are pointed as seen in Figs. 1 and 3, p. 268, and the former were the first to show serious signs of weakness in themselves, and to cause deformation of the triforium and clerestory arches. As we have already said, De Waterville's high tower had to be taken down because it proved to be too heavy, and it was, without doubt, the great weight of this that caused the incipient destruction of the foundations of the south-east and north-east piers, and also of the south-east pier; for before the erection of the existing lantern the south-east pier was banded with wrought iron bands, made tight with wood balks and wedging pieces, forming a swathing, as seen in Fig. 3. This pier had, therefore, shown signs of crushing or crippling, and it was unwise of Dean Kipling to add even the weight of the corner turrets. Early in the present century, a strong link band of wrought iron was carried along the string course just below the clerestory of the south transept, and round the south-east pier, to prevent the movement which was going on; but this seems to have had little effect, unless to increase the destruction, for this transept, as well as the northern one, is undoubtedly weak on its foundations, and its settlement tended to the further destruction of the feeblest pier. Solid masonry was also introduced between the two arches next the pier to support it, but the disintegration of the tower proceeded as before, until, in spite of the cement courses shown in Figs. 4, 6, 7, and 8, which were put in about seven years ago—sheared and cracked a few years after being put in—it was decided to take the tower down to the ground stone by stone, and to re-erect it without the turrets; but if the public subscriptions which are invited are sufficient, the lantern will be carried up a stage higher than now.

An examination of the tower and transept shows that the whole of the destruction is due chiefly to the failure of the two piers mentioned, though it is probable that the other piers have subsided a little, as well as the transepts. The arches and columns in the east walls of the transepts near the tower, and in the nave, also near the weak piers, are much deformed, and the string course as shown at Fig. 1 equally show the nature of the destructive crippling. Peterborough is to a great extent founded on a bog; but the site of the cathedral, which is about 30ft. above sea level, seems to be clear of this, though the marly gravel below the foundation is very wet. It has been sometimes suggested that the drainage of Wittlesea Mere thirty years ago, and of the town of Peterborough about six years ago, may have had some effect on the foundations, though this does not appear evident. The greater settlement of the north-east, and particularly of the south-east, pier shows that the foundations were unequal; and it is the experience of Mr. Thompson that

FIG. 9.



the Normans were habitually less careful of their foundations than the fourteenth century builders, and though their work has stood well where large stones were available, it has often failed where the buildings were a considerable distance from the quarry, as at Peterborough, for there they used very small stones, and seem to have done little more than throw the irregular stones into trenches dug but to a small depth, and in few cases to have made any footings to their thicker walls. At Peterborough, moreover, the lime was of a poor character, and the sand employed seems not to have been free from vegetable matter, the result being that to-day the mortar with which they built is little better than loose sand, and from the rubble filling of the weak piers it will run out like sand in an hour glass. It must, however, be admitted that the piers are not as strong or so large in sectional area as many others in similar buildings. Thus, Norwich Cathedral has a tower of a weight, including its spire, equal to the four-storeyed structure intended at Peterborough; yet it has remained secure, because of its greater thickness of pier. The span of the Norwich supporting arch is 23ft.; that of Peterborough is 35ft. The height of the pillar at Norwich is 45ft.; that at Peterborough, to the caps, is 53ft. The diameter of the Norwich pillar is 10ft.; while that of Peterborough is much less. This comparison shows a disadvantage at Peterborough of about two-thirds less effective support. Still, the subsidence of the south-east pier was with little doubt the first cause of dilapidation, whilst the north-east pier undoubtedly yielded from similar causes, and contributed materially to hasten the deplorable condition of the whole tower.

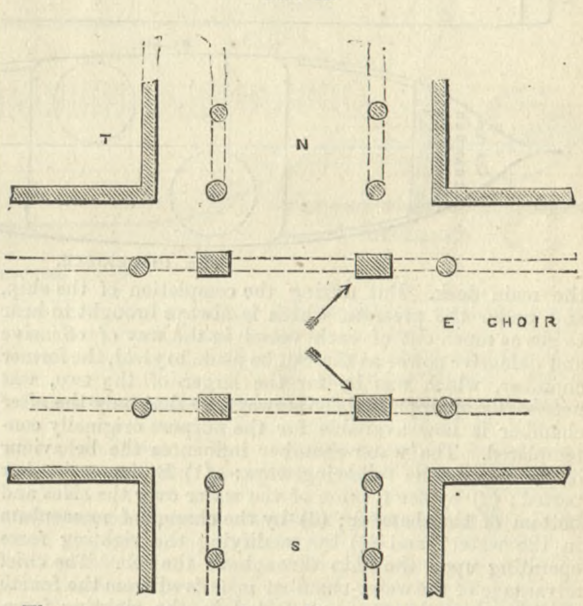
The section of the piers is shown in Fig. 10. Taking the sectional area of this at 85 square feet, and the weight of the stone of it and the work above it, at 13 cubic feet to the ton, it will be found that the weight on the piers is between 1600 and 1700 tons. This would not be a great weight, but the acting masonry of the piers seems to be small, for a large proportion of the interior is mere loose rubble, so that the piers, and especially the south-east and north-east, are little more than masonry casings. The stone of which the cathedral is built is from the Barnack quarries, near Stamford, and is a fine sandstone, which stands well. Mr. Thompson has had very wide experience in restoring buildings of this kind, including the cathedrals of Lichfield, Hereford, Bangor, Chester, and Ripon; and at Croyland Abbey, not a great distance from Peterborough, he found that the foundations were little more than rubble banks, with mortar, now, as at Peterborough, like loose sand.

The annexed diagram, Fig. 11, not to scale, shows the plan of that part of the cathedral near the tower, and the arrows show the direction in which the greatest subsidence has taken place, owing to the greater settlement of the piers to which they point. The Norman arches spring from east to west, and the pointed from north to south. The former have a rise of 14ft. 3in. and the latter of 23ft. 6in.

From an examination of Figs. 1, 2, 3, and 5, which show the filling above three of the four arches supporting the tower, it will be seen that the relative movement caused by differential subsidence of the piers and the connected transept and nave walls, has completely destroyed all union of the masonry, and this not only by disruption along the joint lines of the stones, but in many cases the shearing forces brought into play have sheared stones of considerable sectional area. This is particularly noticeable in Figs. 1 and 2. The disintegration as shown at Fig. 2, which is a faithful copy of the photograph, makes it remarkable that active measures for preventing a fall were not earlier necessary. It may, however, be thought that this complete, instead of partial, disintegration of the masonry above both of these arches was much less likely to cause their failure than a single crack just above the haunches, if the rest had remained whole and firmly connected to the main heavy outer walls. Fig. 3 is a view from the south, looking into the northern transept, the near pier on the right being the swathed south-east pier. Through the hole in the floor above, which is 30ft. above the caps of the piers, may be seen one of the windows of the north wall of the lantern, a portion of this wall being given in Fig. 6. Portions of the south and east walls are shown in Figs. 8 and 7. These illustrations sufficiently show that what might appear to be due to general decay is really the consequence of unequal subsidence of the foundations, and although the piers are weak, there is little doubt that they would have stood if their foundations and filling had been good.

The work at present going on consists in the erection of heavy staging from the ground to the soffits of the arches and in the centre of the tower; the former is to give complete support to the arches, while the great central staging will be carried up to the top of the lantern, and then carry a steam crane, which will lower the stonework down to another staging carried up to the level of the springing of the lantern, and provided with another steam crane with which the material will be lowered to the ground. It will be seen that one crane on the central staging could not take the stones and lower them beyond the tower down the corner between the nave and transept walls. Two are thus necessary. The stones will be marked with a view to their restoration in the places they now occupy.

FIG. 11.



The operation is one demanding considerable judgment and care; but there is little doubt that under Mr. Thompson the work will be successfully carried out; and it may be expected that the public liberality usually shown in these matters will enable the restoration to be carried out completely, so that the tower may have the fitting proportions originally given to it be De Waterville.

TENDERS.

DEEPENING AND WIDENING THE RIVER SOAR, &c.

TENDERS received by the Corporation of Leicester for the deepening and widening of the River Soar and the Leicester Navigation, including concrete towing-path walls, the construction of a new stone weir, and works in connection therewith, according to plans and specifications of Mr. J. Gordon, C.E., Borough Surveyor. Quantities prepared and supplied by the Borough Surveyor.

	£	s.	d.
Kellett and Bentley, London—accepted	13,699	18	5
Whittaker Bros., Hosforth	14,200	0	0
S. W. Pilling and Co., Manchester	14,762	18	10
G. B. Godfrey, Hull	15,132	10	0
Foster and Barry, Scarrington	15,174	0	0
S. and W. Pattinson, Sleaford	16,349	0	0
Geo. Lawson, Glasgow	18,346	0	0
A. Palmer, Birmingham	18,592	1	10
Small and Sons, Dewsbury	20,748	15	2
J. Jackson, London	20,827	2	9

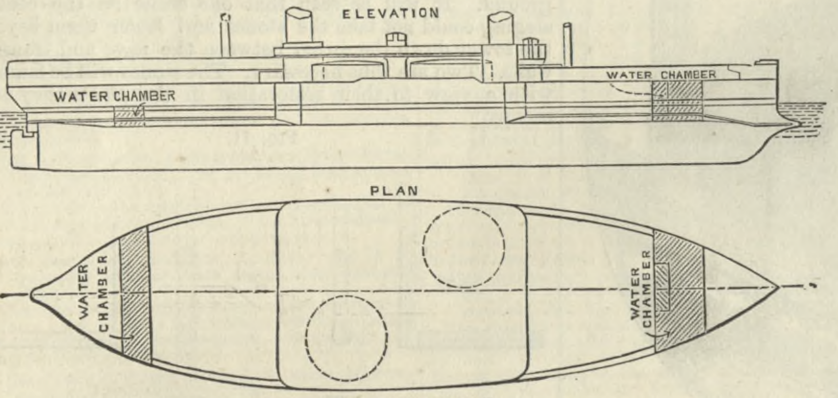
THE SOCIETY OF ARTS.—A course of three Cantor lectures on "The Decorative Treatment of Metal in Architecture," will be delivered by Mr. E. H. Birch, Assoc. R. Inst. B.A., at the Society of Arts on Mondays, April 2nd, 9th, and 16th. The first lecture will deal with the decorative treatment of the precious metals in ancient architecture, and its occasional use in Egyptian, Assyrian, Babylonian, Mede, Persian, and Jewish Architecture, as well as in Greek and Rome, and during the Christian Dispensation. This will be followed by a reference to the Bronze age; the nature and qualities of bronze; its earliest use in Nineveh, Babylon, Mycenæ, Etruria, and during the classic period. The subject of bronze will be continued in the second lecture, when its history will be carried to the culminating point during the Renaissance. The Art of the Blacksmith, and the use of wrought iron in the North of Europe will then be referred to. Ironwork will be continued in the third lecture, and an account given of its development at Augsburg and Nuremberg in fifteenth and sixteenth centuries, and in England in the seventeenth century. The Artistic Treatment of Lead in the Middle Ages will then be considered; and in conclusion the lecturer will make some remarks on the use and and abuse of metal work; on modern bronze work; on the decorative treatment of the metals, as applied in these days; and point to our failures and successes. An Exhibition of Metal Work will be arranged in connection with the lectures.

THE INSTITUTION OF NAVAL ARCHITECTS.

The business of the meeting was resumed on Friday, the 16th ult., at 11 a.m. The first paper read was by Mr. P. Watts,

On a Method of Reducing the Rolling of Ships at Sea.

The object of this paper was to draw attention to a method of reducing the rolling of ships at sea. When the Inflexible was in course of being designed, it was found necessary to accept great metacentric height in the normal condition, in order that when the ends were injured, or partially destroyed, the vessel might still have sufficient stability. Instead of a metacentric height of about 3ft., which would otherwise have been deemed sufficient, a metacentric height of nearly 8ft. had to be adopted. This gave a metacentric period of 10·7 sec.; and it was recognised that this shortness of period would necessarily tend to produce quick and deep rolling under conditions of sea likely to be often met with, although the great beam and flat floor of the ship were likely to favour steadiness. The consideration arose whether it would be possible by some device to considerably reduce the metacentric height in the normal condition for ordinary sea-going purposes, and thus reduce the tendency to roll; or to increase the resistance to rolling possessed by the ships considerably beyond that possessed by ships under ordinary circumstances or to effect a combination of these results in a greater or less degree. Several devices were discussed; that preferred and adopted was the device known as "water-chambers." These were compartments across the ship into which free water might be admitted when it was required to reduce rolling. Two compartments were originally set apart for this purpose—as shown in the cut—one forward and the other aft, the one forward being 22ft. long and extending from the armour deck to the upper deck, and the one aft 14ft. long, and extending only from the armour deck to



THE INFLEXIBLE.

the main deck. But during the completion of the ship, and under the pressure which is always brought to bear to get as much out of each vessel in the way of offensive and defensive power as she can be made to yield, the former chamber, which was by far the larger of the two, was necessarily appropriated for stowage, so that only the after chamber is now available for the purpose originally contemplated. The water-chamber influences the behaviour of the ship in the following ways:—(1) By increasing her period; (2) by the friction of the water over the sides and bottom of the chamber; (3) by the change of momentum in the water; and (4) by modifying the righting force operating upon the ship throughout the roll. The chief advantage of the water-chamber is derived from the fourth of these, viz., the change effected in the righting force. The way in which it operates in this respect will be readily followed by regarding the water as doing the reverse to what is done by the men in the process of rolling a ship in still water. The men are timed to run in advance of the roll, and their weight tends to increase the heel; whereas the water in the chamber necessarily lags behind the roll, as the chamber must become inclined before the water has any tendency to run across by its own weight; and therefore it tends to diminish the heel. Thus the effect of the water-chamber is to increase the righting force which opposes the motion as the ship heels over, and on the return roll to lessen the righting force, and cause the ship to move more slowly than she otherwise would, so that she acquires less angular momentum on reaching the upright position, thus tending to make her roll less deeply the other way. In the design of the water-chambers of the Inflexible it was the endeavour to arrange so that the water would move as described under average conditions of sea, &c. Experiments and observations were made in June last with the view of testing how far the object had in view in the design in this respect had been attained; and other questions, such as what height of water in the chamber would give the greatest quelling effect, &c.; and it was also sought to ascertain what was the real value of the water-chamber in reducing rolling. The author was directed to proceed to the Mediterranean and conduct these experiments, and he had since received official permission to communicate the results of the observations made to this Institution. The apparatus used for recording the behaviour of the ship was prepared by Mr. R. E. Froude, at Torquay. But Mr. Watts was unable to carry out the programme contemplated on account of the ship being required for service at Alexandria in connection with the recent Egyptian difficulties. The sea-way rolling of which records were taken took place on the 16th of June last, when the ship was lying twenty or thirty miles off Alexandria. On this occasion she rolled upwards of 30 deg. from out to out. The wind blew with considerable force from the N.N.W. during the previous night, but fell towards the morning. At 10 a.m. it was said to be of force 5, and it fell off somewhat during the time the observations and records were taken. The sea was irregular, but its general character remained nearly the same while the experiments were being made, it being somewhat less irregular towards the close of this time, and the waves fell off somewhat in size, but series of big waves were frequently met with. The larger waves were of about 10·5 sec. period, and averaged from nine to twelve feet high. The ship was allowed to lie passively in the trough of the sea while the experiments were being made—from about 9 a.m. till 3.15 p.m. The intention was to commence with the water-chamber empty, and record the behaviour of the ship for about half an hour, then fill up the chamber by stages, and take records for half an hour in each condition; but the water in the chamber was dashed about with such violence that, after the first two or three experiments, it was found impossible to keep the hatch open, so that the water admitted at each stage after this could be only very roughly estimated. Records were taken, first, with the water-chamber empty, then with 40 tons of water in the chamber, then with nearly 55 tons of water, next with 60 to 70 tons; in the next two cases the quantity of water was unknown, but probably it varied in these from 70 to 85 tons and from 85 to 100 tons respectively. As much water was then allowed to run in as would at that draught and trim, and probably the chamber contained 120 tons out of 130 tons which it will hold when full; and, finally, records were again taken with the chamber empty. The author then proceeded to consider the results obtained at some length. Taking a mean between the results obtained with the water-chamber empty at 10.7 a.m. and at 3 p.m., they obtained: Mean absolute inclination for 1 deg. of mean wave slope = 5·51 deg.; mean relative inclination for 1 deg. of mean wave slope = 5·84 deg. And taking a mean between the results obtained with from 50 to 55 tons of water in the water-chamber, and from 60 to 70 tons in the chamber, we obtain: Mean absolute inclination for 1 deg. of mean wave slope = 3·26 deg.; mean relative inclination for 1 deg. of mean wave slope = 3·71 deg. Hence, by filling the chamber about half full of water the rolling was reduced by about 37·5 per cent. It will be probably within the truth to say that the water-chamber, when about half full, reduces the mean angle of roll by 30 per cent. when the ship is rolling broadside on amongst waves of from 9·5 to 10 sec. mean period. Some further experiments which are shortly to be made will probably settle some other questions in connection with the matter which yet remain to be decided.

The discussion was opened by Mr. Froude, who referred to the mechanical action of water, and explained that when men were employed to roll a ship they did work on her, and the greater the work the more they went up-hill by climbing the inclined deck. Water, on the contrary, tended to prevent rolling, the ship having to do work on it, and the greater the incline down which the water ran the more efficient was it. It was a fallacy to suppose that it was the friction of the water that steadied the ship. Friction did harm by tending to prevent the movement of the water. Admiral Sir John Hay feared that space was too valuable in ironclads to spare it for steadying chambers. It was not against rolling they wanted protection when fighting guns at sea, but against lurching, which was quite a different thing. Mr. Morgan explained that fresh water might be carried in the steadying tank, which would thus be utilised. Mr. John looked upon the whole scheme as fraught with danger, and cited instances to prove that water getting loose in ballast tanks might do fearful mischief.

Sir E. J. Reed endorsed all that Mr. John had said, and hoped that it would not go out to the world that the Institution of Naval Architects saw no danger in the use of water as proposed by the Admiralty. As for lurching, loose water was the very thing to encourage it and magnify its evils, because, when a ship was heeled, it would help to hold her down like a shifted cargo. Mr. Barnes pointed out that the tank in the Inflexible was so small that its use could involve no possible risk. Mr. Martell warned his hearers against the use of loose water, and pointed out that the most stringent precautions should be taken to keep water ballast tanks full. Mr. Samuda spoke briefly to the same effect. Mr. Barnes pointed out that what might be true of cargo steamers did not apply to men-of-war. Mr. Rundell said that the whole theory involved in Mr. Watts' paper was based on the notion that they could have waves of regular periodic time to deal with. That was not so, however, and the Devastation had in one case to wait for three weeks on the West Coast of Ireland before she got waves of the right kind for certain investigations which the late Mr. Froude was making.

Mr. Watts replied, and explained that no matter what the variations in the wave periods, that of the ship was fairly constant, and in regular curves. It must be remembered that what they wanted to do was diminish the stability of the Inflexible, not augment it, as would be the case if the water were used as ballast. The Earl of Ravensworth recorded a conversation with a very able captain of a Cunard steamer, who gave it as his experience of the Atlantic that no wave theory could be laid down, there were so many disturbing influences at work. A vote of thanks was then passed.

The second paper read on Friday was by Mr. W. W. Rundell, secretary to the Underwriters' Registry of Iron Shipping,

On Tonnage Measurement, Moulded Depth, and the Official Register in relation to the Freeboard of Iron Vessels.

The much-discussed topic of tonnage measurement was only referred to in this paper so far as it relates to the question of freeboard. This was an extremely technical paper of limited interest. The author sought to establish two points. The first relates to the coefficients of fineness. These coefficients had no fixed relation to ordinary curves of displacement when expressed in percentages of total displacement and of moulded depth. He wished to show that it is possible for the same curve of displacement when expressed in percentages to truly represent vessels of every degree of fulness or fineness from coefficient ·60 to coefficient ·80. The curves, as already intimated, show the mode in which the displacement for different forms increases with each unit of immersion. Thus, the square box for each increment of immersion, or depth, increases throughout by equal increments of displacement. The triangular prism, with one angle downwards, increases the displacement much more rapidly; at the second unit three times as much as at the first; at the third unit five times as much; at the fourth unit seven times, and so on to the end; and this is true whether the downward angle of the prism be acute or obtuse, all we have to consider being the rate of increase. Each curve of displacement indicates the rate of increase of the displacement of the vessel as unit by unit she is submerged. Now, if we take a vessel of a given moulded depth, say, of coefficient ·70, and regularly increase or decrease the areas of every water line from the deck to the keel in the same proportion, it is evident we may obtain vessels for coefficients ·60 and ·80 which will have identically the same displacement curve as the one with coefficient ·70, providing always that the same proportion of total displacement is retained for sheer and round of beam. It will also equally well represent vessels corresponding to all the intermediate coefficients, for by hypothesis their displacements all increase in the same proportion throughout. Consequently, in all these vessels the same percentage of buoyancy will be cut off at the same height, and any tables which give a different freeboard to each of them and for the same percentage of displacement, clearly attempt that which is not possible. The second point he wished to establish was that when the spare buoyancy and the moulded depth of a vessel are given, any stipulation as to her freeboard practically defines the form of a vessel. It defines within narrow limits that part of the displacement curve which is concerned with freeboard. Take, by way of example, moulded depth 26ft., reserve buoyancy 30 per cent., and freeboards represented by 24 per cent., and 27 per cent. of moulded depth. This difference of 3 per cent. is equal to nine inches, the difference of freeboard given by a table prepared by the author between the coefficients ·60 and ·80 Was it not, then, quite correct to say that tables which connect percentage of buoyancy and moulded depth of a vessel with a fixed freeboard thereby also define in a very important respect the model of the vessel? Granting, in the absence of a complete displacement scale or any ready means of calculating the freeboard which corresponds with any required percentage of reserve buoyancy, that it may be convenient to have a linear scale, he would offer an easily-remembered one for a vessel of medium form, which shall correspond to a nicety with the new tables for steamers which have been issued by the Committee of Lloyd's Register: for these new tables are purely lineal in character. The old Liverpool scale for wooden vessels may be briefly stated thus:—A fair freeboard is an allowance commencing at 2·2in. per foot for vessels of 10ft. depth of hold, and increases regularly by 0·1in. per foot with each additional foot of depth. According to the new Tables by Lloyd's Register, a freeboard for iron steamers of medium form, which under no circumstances may be exceeded—as half an inch deeper would apparently render the ship technically unseaworthy—is as follows: 1·7in. per foot for 10ft. moulded depth of vessel, and 0·1in. per foot additional with each additional 2ft. in the moulded depth.

The discussion was confined to a criticism by Mr. Martell of this paper, and an explanation that in all cases Lloyd's tables had been found consistent with practice and accurate. Mr. Rundell replied, and a paper was then read by Mr. Henry West, Chief Surveyor, Underwriters' Registry for Iron Vessels,

On the Assessment of Deck Erections in Relation to Freeboard.

The author began by asking "What is the object of freeboard? What are its functions?" Perhaps the most important of these are:—To limit the ship's load; to provide a reserve of buoyancy, both as a margin against leakage and as lifting power in a sea-way; to assist in securing a sufficient range of stability; to provide a suitable height of working platform, and to protect the vessel from deck damage. When we consider these various functions, and how the conditions which call them into play vary both in degree and combination, we shall, he thought, be ready to admit that the instinct which has always led the experienced and self-reliant shipowner to protest against any fixed load line is a true one. He knows how apt a so-called "fair load line" is to crystallise into a "hard-and-fast line," the enforcement of which would seriously cripple him in his business; and how, on the other hand, an authoritative "maximum load line" would too often be claimed as a legalised draught, and even be used, ignorantly, under conditions which would court disaster. He then went on to say that the officers of Lloyd's Register have most perseveringly attacked the problem of a load line, and after several *quasi* public and more or less successful attempts, have at last issued an official manifesto on the subject. In a series of very carefully adjusted tables, with an elaborate preface, they have given a load line for almost every conceivable ship which has been or which can be built. It will be interesting to trace whether, and at what stage in their history, these tables have secured any important support from the great body of shipowners. We have it on the authority of the compiler of the tables upon which the amended and re-amended tables have been founded that they were originally framed on the practice of shipowners "you would like to follow;" and he knew no safer guide, in such a matter, than the experience of those owners whose reputation for good management and whose immunity from accident have justified their practice. But how was this formulating of the good practice of the day then received? For answer, he quoted from the "Final

Report of the Royal Commission on Unseaworthy Ships":—"Witnesses who have examined this scheme say that if such a test were applied and enforced, ships which have hitherto made their voyages in perfect safety could no longer be profitably employed." After some important alterations the tables were again put forward, and in the early part of last year were widely circulated for criticism.

TABLE A.

Depth. Moulded. Ft. in.	Depth. Hold. Ft. in.	Freeboard in inches by tables of October, 1873.	Freeboard in inches by tables of March, 1882.	Freeboard in inches by tables of August, 1882.	Difference in inches between tables of October, 1873, and March, 1882.	Percentage of reduction.	Difference in inches between tables of March, 1882, and August, 1882.	Percentage of reduction.	Difference in inches between tables of October, 1873, and August, 1882.	Percentage of reduction.
10·0	9·3	19·75	19·0	16·5	0·75	3·79	2·5	13·15	3·25	16·45
15·0	14·0	32·5	31·0	28·5	1·5	4·61	2·5	·06	4·0	12·30
20·0	18·9	50·5	45·0	43·5	5·5	10·89	1·5	3·3	7·0	13·86
25·0	23·6	72·25	64·5	61·0	7·75	10·72	3·5	5·42	11·25	15·57
30·0	28·3	103·0	91·5	80·	11·5	11·16	11·5	12·56	23·0	22·33

TABLE B.

	Freeb'd in inches by tables of Oct. 73.	Freeb'd in inches by tables of Mar. 1882.	Freeb'd in inches by tables of Aug. 1882.	Difference in inches between tables of October, 1873, and March, 1882.	Percentage of reduction.	Difference in inches between tables of March, 1882, and August, 1882.	Percentage of reduction.	Difference in inches between table of October, 1873, and August, 1882.	Percentage of reduction.
By table ..	53·25	46·5	45·0	6·75	12·67	1·5	3·22	8·25	15·49
Less deduction for erections	3·55	9·90	12·3	—	—	—	—	—	—
Final freeboard ..	49·7	36·6	32·7	13·1	26·35	3·9	10·65	17·0	34·2

In Table A he had grouped together for comparison the freeboards assigned by Lloyd's Tables of October, 1873; March, 1882; and August, 1882; for vessels of medium form—co-efficient ·74—of 10ft., 15ft., 20ft., 25ft., and 30ft. moulded depth. He had also shown the difference between the freeboards of 1873 and 1882 in columns of inches and of percentages. Again, in another table—B—he had given the same particulars for a screw steamer, 260ft. × 34ft. × 18ft. 9in. hold, and 20ft. moulded depth, with ·78 co-efficient of fineness, having a long raised quarter-deck 3ft. 6in. high, with bridge-house and forecastle, the combined lengths of which amount to seven-tenths of the vessel's length. In these illustrative cases the freeboard has been reduced between October, 1873, and August, 1882, in no instance by less that 12 per cent., and in one case by 34 per cent. These figures show that the practice of shipowners one "would like to follow" has been pared down by no flinching hand. He could not blame shipowners if, under the harassing pressure of recent legislation, they were ready to welcome a load line which bears the honoured name of Lloyd's, and which, if necessary, may be made to justify even a somewhat extreme practice. They were told the freeboard for vessels crossing the North Atlantic in the winter months—one of the worst voyages that the world knows. What do we find to be the difference of freeboard assigned by the Tables to such conditions and those for calm weather and a smooth sea? A matter of a few inches only. In the very largest flush-decked vessels which the Tables contemplate it amounts to less than 9in., and in the smaller type of steamers which would brave an Atlantic winter, 3in. is the whole difference. The author then considered the value of deck-houses and over-deck buoyancy. The surveyors of the Underwriters' Registry for Iron Vessels have given a good deal of attention to this problem, and the author now submitted for consideration and criticism the conclusions at which he had arrived. In approaching the question he started with the intention of stating for any vessel the mean draughts which would, with practical accuracy, immerse certain definite percentages of the whole volume of the vessel, or their equivalents. The percentages decided upon were 65, 70, 75, and 80 per cent., corresponding to reserves of 35, 30, 25 and 20 per cent. respectively. These figures were not intended to indicate load lines, but simply to show the lines of immersion at which such percentages would be reached, and were adopted because the committee of the Underwriters' Registry, having determined to give complete displacement scales on their certificates of class, decided specially to mark the mean draughts which corresponded to these percentages. It is obvious that to do this for a flush-decked vessel is a matter which simply involves a calculation of the whole volume of the ship, including sheer, round of beam, and thickness of deck; and the preparation of a displacement scale from which the specified percentages, or any others, can be read off. But when to this displacement under deck had to be added an assessed value for the displacement above deck, the matter became more complex, and it was necessary to discuss some general principles, and frame some general rules, which should be applicable to all the cases contemplated. The body to which he belonged decided that the assessment of deck erections should be in terms of under deck displacement—that is to say, that each unit of displacement above deck should be assessed as some fraction of the same unit under deck. We will call this fraction the co-efficient of assessment. He then explained the method by which they obtained the following equation for the value of the co-efficient of assessment C:—

$$S \times R \times r \times p = C.$$

Where S = the structural element—that part of the value affected by strength and efficient closing-in; R = the ratio of displacement; r = the ratio of height; p = the element of position. Having thus obtained a co-efficient of assessment, if we put t for the displacement of the particular erection to be assessed, Ct will be the assessed value of that erection in terms of displacement under deck; which value, added to the displacement under deck, gives the total assessed displacement. Of this total the displacement scale gives the means of at once drawing the various percentage lines. This method gave them an assessment which takes into account actual and relative capacity of the erection, its strength, its height, and its position. They had no hard-and-fast lines, no sudden steps. The ship's form and dimensions, the actual facts of each case, govern the assessment in every respect, except in the choice of the factor for strength and structural efficiency. This would be the province of the surveyor. He would choose what factor between 1 and 0 was applicable to the particular case, and he would be guided in his choice, not only by the strength of the erection, but also by the number, kind, and position of openings therein, and the means available for closing them. But his choice once made, the rest is a mere matter of arithmetic. Even this margin for difference of opinion might be minimised if the Classification Society would decide the value for S for average cases of each type of erection. Any departure from this value, in either direction, would then have to be justified to, and confirmed by, the Classification Committee.

It will be seen that this and the preceding papers are of much the same nature. It is no secret that a certain amount of rivalry exists between Lloyd's and the body to which Mr. West belongs, and this led to a very animated discussion, apart altogether from the interesting nature of the subject. The discussion took up much time. We can do no more than indicate its character here.

Admiral Horsey held that no deck structures should be included in freeboard. They were not water-tight, and could not keep a ship afloat with her deck awash. Mr. Withey explained that deck erections were considered good on the north-east coast, because they extended to the side of the ship, and were, as far as possible, entered from the top. As to freeboard, it should not be forgotten that simple buoyancy was of no use to keep a ship afloat until she began to sink, and what it ought to be was determined by conditions varying with the ship and her cargo. He never could help regarding the Board of Trade rules prepared by Sir Digby Murray with astonishment that any great maritime nation like this could consent to be led by such utter nonsense. At the same time the question of load-line must not be left to captains and owners only, or they would overload. One of his own built steamers he had seen loaded with 11 per cent. more cargo than she ought to carry. He supported the figures given in Lloyd's Tables. They were not perfect, but they were very good. He then explained that the well-decked vessel was really the outcome of the old steamer with flush deck and high bulwarks. On the deck they had gone on building up, first a forecastle, then a poop, then a bridge-house, and thus had added to the safety of the ship instead of detracting from it. The well-decked ship was safer than any other with close bulwarks.

Mr. Martell, speaking at some length, endorsed all that Mr. Withey said, and ably defended Lloyd's action and the tables they had issued. He thought there was too much science about a somewhat simple matter, and he caused some amusement by humorously pointing out that S in Mr. West's formula might be made to stand for "surveyor," and that the first step in working the equation would be to "square" him.

One gentleman spoke as a shipowner, and hoped that the Board of Trade and Lloyd's could make up their minds and settle something. As to captains, no two of them agreed as to what was right; and as to cargo, the ship was often chartered to carry so much dead weight, the shipowner did not know of what, till it came to be put on board.

Mr. White bore testimony to the soundness of Lloyd's Rules, and criticised those of Mr. West. Mr. Raylton-Dixon held that deck houses should not be included as surplus buoyancy. Mr. John held that the question could not be settled properly unless due consideration was paid to the strength of the ship, and especially of those portions above the load line.

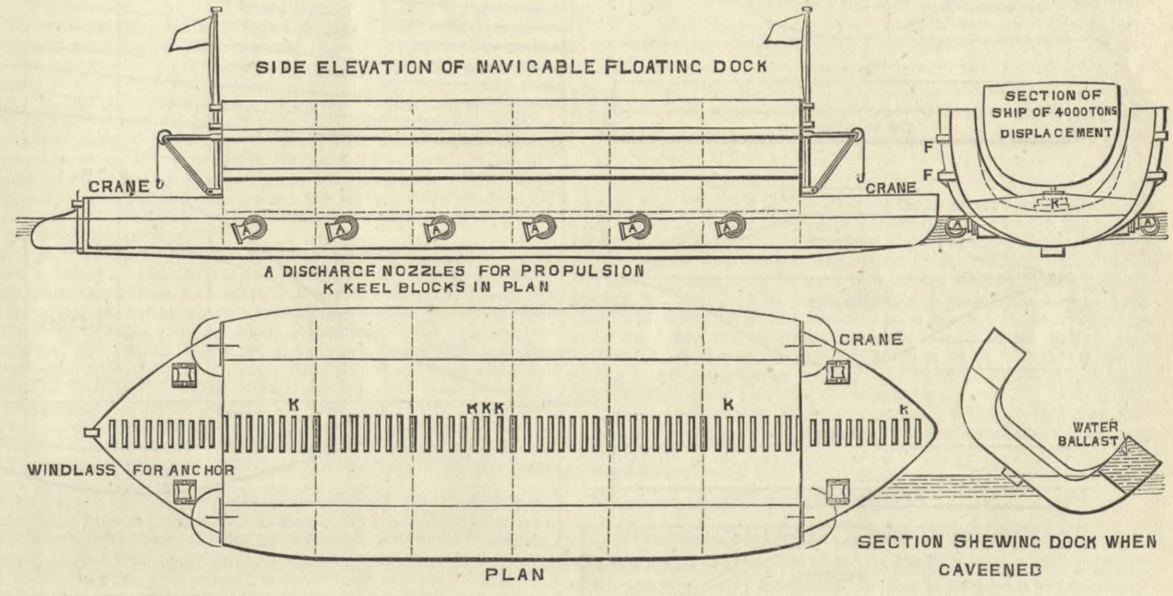
Mr. Rothery endorsed all that Mr. Withey had said, and held that some conclusion ought to be arrived at by all parties concerned.

A few more remarks were made, and Mr. West replied very briefly, pointing out that the formula provided just what Mr. Martell wanted, and could be worked by a fairly educated school-boy.

The next paper read was by Mr. Rennie,

ON A SELF-PROPELLING, SELF-CAREENING FLOATING DOCK.

The author proposed to make the dock of (1) suitable form and strength, so that ships may be easily docked without the use of either gates or caissons—as at Carthagena—and of a form easily propelled at a moderate speed through the water. (2) To make the pumping machinery for emptying the dock also serve the purpose for propelling it through the water. (3) By giving the dock such a sectional form that by means of water ballast it may be careened over first one side and then the other up to the keel line. No. (1) may be best explained by reference to the drawing. No. (2): the means proposed for this is utilising the machinery for pumping out the dock for propelling it by means of the water discharged in the contrary direction to which the dock is to be propelled. The example best known of this system of propulsion is that of H.M.S. Waterwitch, but which, compared to similar ships, such as the Viper and Vixen, propelled by twin screws, did not give such a good result of speed for power. Thus, the Waterwitch gave only 9·3 knots, with 760 indicated horse-power, whereas the Viper gave 9·6 knots with 696 indicated horse-power. This difference seems to the author to be fully accounted for by the small propelling area of the water jets, only about $5\frac{1}{2}$ square feet in the Waterwitch, whereas the disc area of the two screw propellers was 127 square feet in the Viper, or as 1 : 24. In ships of the usual construction the water jet propellers seem to be difficult of application in consequence of the large inlets and outlets that would be required for the passage of the water to give a good result as compared with screws or paddles. In the case, however, of a floating dock, the case is quite different. Here large pumping power is required for emptying the different compartments, and this can be distributed along the length of the dock on either side; and although the power for emptying the different compartments of the dock would not be required



RENNIE'S FLOATING DOCK.

to the extent necessary for propulsion, even at a very moderate speed, there would be no disadvantage in having a surplus power for that purpose. The maximum speed that seemed to him to be necessary for a floating dock to be propelled to its destination, or from port to port, should not exceed five knots, and probably four knots would be found sufficient. The propelling power for such a speed, with the necessary propelling area, such as would be considered a proper proportion if the paddle or screw were adopted, could easily be distributed in several sets of pumps and engines, with separate suctions and discharges, on either side of the dock; the area, pressure, and velocity of the discharged water being made in proportion to the propelling speed required. In the drawing shown, which is for a dock 350ft. in length, and suitable for ships of 4000 tons weight, six sets of engines, pumps, and discharging nozzles are shown on each side, which may be compared in their disposition to the oars or paddles of a boat or canoe. (3) The careening of the dock would be effected by utilising the pumping machinery for filling the water-ballast chambers on either side. The engines would then be stopped and all made secure for careening, when the sluice valves on the side to be raised out of the water would be opened, the dock would gradually heel over, and assume the position shown in the engraving. The form of the section, the centre of gravity of weights, and the weight of water-ballast have all to be carefully considered and calculated, in order that the dock may be careened over, so as to expose the under-water part up to the keel. When one side is done the same operation can be performed for the other side.

No discussion worth recording followed this paper, which was read indeed to about a dozen members. Mr. Liggins praised the idea, and Mr. Stanfield, of the firm of Clark and Stanfield, as was to be expected, did not. A vote of thanks was passed, and this terminated the morning proceedings.

At 7 p.m. the proceedings were resumed. The first paper read was that by Mr. Froude, which we published in our impression for March 23rd. No discussion worth the name ensued. The following paper by Mr. J. Hamilton was then read—

ON THE SPEED AND FORM OF STEAMSHIPS CONSIDERED IN RELATION TO LENGTH OF VOYAGE.

The author stated that he had attempted to look at the subject dealt with from the shipowner's point of view, and for this purpose the accounts relating to an actual voyage had been carefully analysed, and put at his disposal by a steamship owner interested in these matters. The items in the accounts referred to have been split up into six divisions, as follows:—

(1) *The freight or revenue.*—The quantity of cargo that can be carried is always taken as the total dead-weight carrying power, less the weight of coal required for the whole voyage.

(2) *The cost of coal burned on the voyage.*—The quantity

of coal required per day is taken as being in direct proportion to the power developed in driving the vessel, and a fair reserve supply is added, one-third being allowed for twelve knots, two-fifths for ten knots, and one-half for eight knots, on the principle that the time during which the vessel would be exposed to retardation, due to strong winds, would be in about the proportions of 4, 5, and 6. The voyage referred to took 27½ days, and the coal burned was at the rate of 43½ tons per day, giving 1200 tons for the voyage, 400 tons reserve coal, and leaving 1900 tons for cargo. At 10 knots and 8 knots speed the voyage would extend over 33 days and 41¼ days respectively, and the coal per day taken in proportion to the power corresponding to the speed will be 26 tons for 10 knots, and 13 tons for 8 knots. At 10 knots the coal required for the voyage will therefore be 33 × 26 = 856, and taking 342 for reserve, 2202 tons are left for cargo. At 8 knots the coal required would be 41¼ × 13 = 536, and with reserve of 268, leaving 2606 tons for cargo.

(3) *Oil waste and engine-room stores.*—This item is supposed to increase or diminish in proportion to the power developed by the engine, or as the coal burned, which would be a measure of the heat produced, and therefore of the oil, &c., used.

(4) *Lights, dues, pilotage,* and all expenses of this nature, which are chargeable each voyage, and depend on the size or tonnage of the vessel, and not on the cargo carried.

(5) *Cargo dues, stevedoring, brokers' commissions,* and all similar expenses which depend on the cargo carried. This is assumed to be always in proportion to the freight, the rates being regarded as constant.

(6) *Wages of officers, engineers, crew, &c., victualling and provisioning the ship,* and all expenses belonging thereto. This is assumed to be a fixed sum for a given length of time.

The number of voyages that would be made in a given time would be as the speeds, namely, as 12, 10, and 8, if the time spent in port followed the same proportion, but this will be regulated by the dead weight put in or taken out. In loading, the total weight being the same in all cases, the same time will be taken up per voyage, but in discharging only the cargo is put out, and the time in port will vary as the quantity. Allowing, therefore, a day for every 426 tons put in or taken out, we have 8 days to load and 4½, 5, and 6 days per voyage for discharging. This added to the steaming time gives 40, 46, and 55¼ days required per voyage, at 12, 10, and 8 knots respectively; or in 360 working days, say, 9 voyages, 7·8 voyages, and 6½ voyages. Making use of these figures, then, and basing the comparison on the principles already described, he had worked out the comparative earnings for speeds of 10 knots and 8 knots, and placed these alongside of the figures relating to the actual voyage in the following table. The total dead weight was 3400 tons:—

TABLE I.

12 knots.	10 knots.	8 knots.
Steaming time.. 27½ days	Steaming time.. 33 days	Steaming time.. 41¼ days
Coal, 43½ tons per day...... 1200 tons	Coal, 26 tons per day ...... 856 tons	Coal, 13 tons per day...... 536 tons
Reserve ...... 400 tons	Reserve .... 342 tons	Reserve ...... 268 tons
1600	1198	794
(1) Freight, 1900 at £3 5s. .. = 6,200	Freight, 2202 at £3 5s. .. = 7,156	Freight, 2606 at £3 5s. .. = 8,470
(2) Coal, 1200 at 12s. 5d. = 745	Coal, 856 at 12s. 5d. = 531	Coal, 536 at 12s. 5d. = 332
(3) Oil 88	Oil 62	Oil.. 39
(4) Lights, &c. 415	Lights, &c. .. 415	Lights, &c... 415
(5) Cargo dues 706	Cargo dues .. 817	Cargo dues .. 960
—— 1,954	—— 1,825	—— 1,746
4,246	5,331	6,724
£4,246 × 9 = 38,214	£5,331 × 7·8 = 41,581	£6,724 × 6½ = 43,706
Less item (6) wages 15,714	Less 15,714	Less 15,714
£22,500	£25,867	£27,992

The results of this comparison are represented graphically by curves. Here, then, is an example of a vessel, taken from actual practice, which is being driven at a speed too great for economical steaming on a voyage of 8000 miles, and we find that the earnings in a given time would be increased by reducing the speed considerably on such long voyages. After referring to diagrams illustrating certain points, the author went on to say that they would see that in an Australian voyage, say, of 12,000 miles, the profits would be doubled by running the vessel they were considering for any given number of voyages at the speed of 8 knots per hour instead of 12 knots, the rates of freights, dues, cost of coal, &c., being the same. He did not know if shipowners realised that what may be the most economical speed for a short voyage may be ruinous for one of twice the length, but, on account of the necessity to provide coals for the whole voyage, it is so. The common practice, however, is to try to evade this necessity by converting a long voyage into two or more shorter ones, by calling at ports on the way, when possible, to re-coal. It is not always possible, however, and is at best a doubtful expedient, as can be easily shown. He next dealt with four types of ship, as in Table II.

	Dimensions.			Displacement.	Ratio of length to breadth.	Coefficient of fineness.	Coal per day at 2 lb. per I.H.P. per hour.		
	Length.	Breadth	Draught.				8 knots	10 knots	12 knots
							Tons.		
A	328·7	35·1	20·05	4200	9·36	·635	8	15·5	27·1
B	309·5	38·2	20·40	4200	8·10	·610	8·4	16·7	29·5
C	286·0	35·1	19·95	4200	8·16	·734	10·1	20·4	39·83
D	269·8	40·8	18·90	4200	6·61	·708	13·6	24·4	48·40

For the vessel marked A, 12 knots would be more economical than 10 knots for voyages up to 5000 miles, but for longer voyages 10 knots would pay better. For B, the best returns would be got by running on voyages under 4000 miles at 12 knots; between 4000 and 7500 at 10 knots; and above this at 8 knots. For C, on short voyages under 2000 miles, 12 knots is the best; for voyages between 2000 and 5200, 10 knots is most economical; and for longer voyages, 8 knots. For D, 12 knots, under 1400 miles; 10 knots for 1400 miles to 5200 miles; and 8 knots for longer voyages, always provided that the revenue is derived by dead-weight carrying alone. This part of the subject was illustrated by diagrams of curves. It would then interest them to know that the difference in money-earning power, even at such a low speed as 8 knots, is, between A the most efficient and D the least efficient, quite equal to the difference that we find existing between one steamship company that makes and divides handsome dividends, and another whose operations result in periodic calls being made on the shareholders. On a voyage to Australia, for instance, it might amount to a difference of 100 per cent. At 10 knots' speed the sharp ship would earn five times that of the full one, whilst at 12 knots speed A would have a handsome sum at her credit, whilst D would have a like sum on the wrong side of her ledger. At even the very slowest speeds the fine forms are superior to the fuller types. A very brief and uninteresting discussion followed.

The next paper read was by Mr. J. McFarlane Gray,

ON FOG SIGNALLING.

The author proposed a new system of signalling. In the system of fog signals at present in operation the signals consist of one, two, or three blasts. A code in which each signal would consist of four blasts would not interfere with the present system, and it would, therefore, be practicable to add such a code of course signals to the present system, leaving it optional either to signal the course or not. In any case it would be well to have every signal in a course code to consist of always the same number of blasts, so that there would be certainty as to whether the whole signal had been heard. A three-blast code is sufficient to divide the compass card into eight arcs; a four-blast code would divide it into sixteen arcs. If the signals consist of the same number of blasts or notes, there must be at least two kinds of blasts, say short and long, or high-pitch and low-pitch, or continuous and intermittent—that is, a clear note and a trill. All these variations have been exhibited by different inventors. A very suitable high and low-pitch whistle for steamers was exhibited at the late Exhibition of Marine Engineering by Messrs. Smith and Sons, Nottingham. The suggested code of four-blast signals can be taught in a few minutes to anyone who can box the compass. It has only to be understood; it is not necessary or even advisable to commit it to memory. He would describe the signals as for a clear note and a trill, which he would call U and R. For clear and trill may be substituted short and long, or high-pitch and low-pitch; the sounds U and R being the same as the words "you" and "are," the signals are easily spoken with these names for the blasts. Any eighth part of a given line can be indicated by the word left or right, three times. Thus "left right left" would mean of the left half take the right half, and of that again take the left half. That would be the third eighth part from the left. In the same way, right left left would be the fifth, and right right left the seventh, from the left. If, now, we had two such lines, we could indicate any of the sixteen parts by prefixing one word to tell which of the two lines the part is in. For the two straight lines we may substitute two curves, say the two semicircles of the compass-card, and for right and left we have east and west. To distinguish which of the two semicircles the part is in, we have to say north or south. We may now put in R and U for these. The first blast would always be read to mean north or south, and all the other blasts will be read east, or else west. As there is an R in north and a U in south, say R for north and U for south. East is on the right of a map; say R for east; and as there is a U—or rather two—in west, say U for west. Let the signal given be R U U R. The first blast R denotes the northern semicircle. The second blast U denotes the quadrant forming the western half of that semicircle. The third blast U denotes the four points forming the western half of that quadrant. The fourth blast R defines the two points forming the eastern half of the preceding four points, or the N. W. b. W. two points. The R U U R has evidently been read north west west east. When the principle of successively halving an already indicated arc, and taking that half which is denoted by the blast is once comprehended, the mind itself provides a compass circle diagram, which it divides, as indicated, at each blast, with the mind's eye fixed upon only the part indicated, without naming the parts. The compass circle having been divided into sixteen parts, through the cardinal points, the middle of each division is a course with "by" in it on the compass-card. No discussion followed.

The next paper read was by Mr. R. Zimmermann,

ON A METHOD OF OBTAINING THE DESIRED DISPLACEMENT IN DESIGNING SHIPS.

The author described a method by which, with very little preliminary calculation, a very close approach to the correct displacement may be ensured, and in which the error will always be so small that keeping the offsets for the loft and for the model full or fine, as the case may be, will be sufficient to rectify it without necessitating an

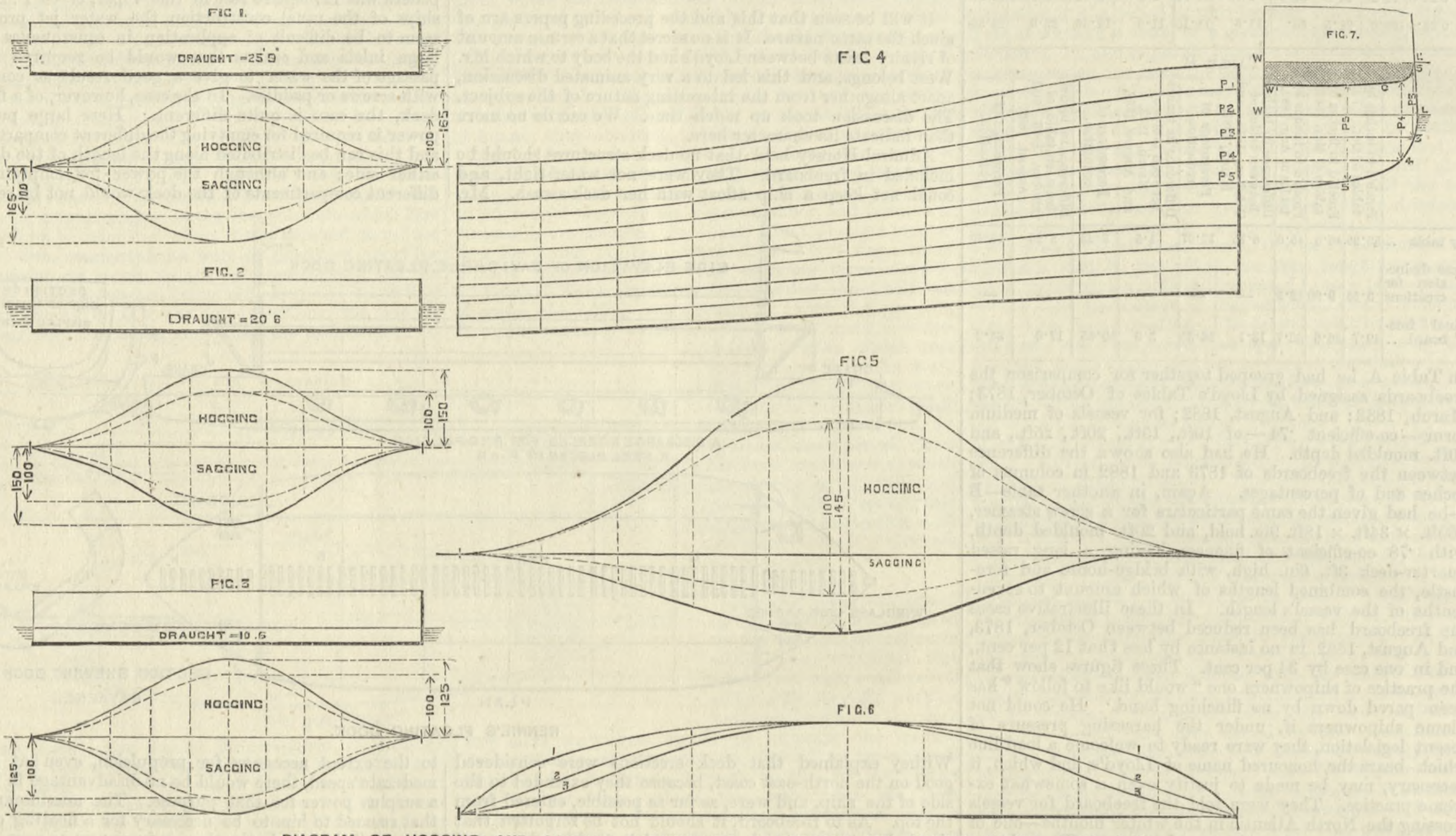


DIAGRAM OF HOGGING AND SAGGING STRAINS, TO ILLUSTRATE MR. SMITH'S PAPER, PAGE 240.

alteration of the lines, whereby much valuable time will be saved. All naval architects who have some practice in designing ships know that lines which appear as diagonals in the body plan, if they are expanded in the half-breadth plan, greatly help to fair the vessel—much more so than the other lines usually used to fix the shape of the vessel. The author discovered that when he began to analyse the bilge diagonal, he found its coefficient of fineness to come very near to the midship section cylinder coefficient of the same vessel. He then calculated all coefficients for a number of vessels, and found that the bilge diagonal coefficient bears a certain relation to the midship section cylinder coefficient; being about equal to it in very full vessels, and getting gradually larger than the midship section cylinder coefficient as the ships get finer, though not in the same ratio, and on this fact he based his conclusions. No discussion followed, no doubt because of the lateness of the hour.

By an error the diagram pertaining to Mr. Kemp's paper on "Steam Yachts" was given last week to illustrate Mr. Smith's paper on "Hogging and Sagging Strains." We now give Mr. Smith's diagram, page 262, while that of Mr. Kemp will be found in its proper place on page 273.

LETTERS TO THE EDITOR.

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

THE PRINCIPLES OF MODERN PHYSICS.

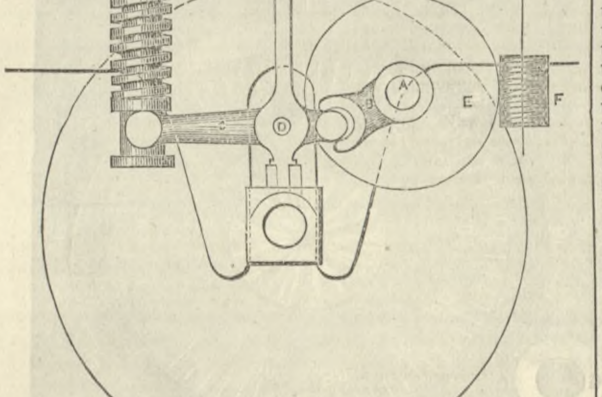
SIR,—In answer to "Student's" problem on the "Conservation of Energy," in your issue of 16th March, I would reply that the position of the centre of gravity of the mass before, and of its products after combustion, remains unaltered; if they descend to the earth again the energy given out was exactly that expended in raising the coal, if they ascend the volume of air that must descend to supply their place will give out precisely the same amount.

In the case of the spring, its energy is expended in stretching the platinum wire, and, as it dissolves, the wire again gives out this energy in contracting to its original length. H. V. L. M.

Dublin.

LINKS IN THE HISTORY OF THE LOCOMOTIVE.

SIR,—The vertical cylinder engines of the Dublin and Kingstown Railway having only four wheels, they pitched and rolled excessively when running at even moderate speeds, and to remedy this defect a pair of wheels was placed under the footplate. As, however, the original weight on the driving wheels was not more than was necessary for adhesion in slippery weather, it was considered imperative that means should be provided by which the most of that weight could be available when required, and the enclosed tracing shows the arrangement which I proposed, and



which the locomotive superintendent adopted to meet the case On the shaft A were short levers B at each axle box, which partly gripped the ends of the levers C, the other end of which acted upon a spiral spring, the pin D becoming the fulcrum of the lever C. When the wheels were on the rails the worm-wheel E was actuated by the worm F and handle G above the footplate.

London, March 29th. THOS. HUNT.

STEAM POWER ON TRAMWAYS.

SIR,—We notice among your "Railway Matters" in the last issue of THE ENGINEER a paragraph calculated to mislead. We shall therefore be obliged if you will permit us to explain that we are informed the four engines supplied by us to the North Staffordshire Tramways are to be placed on the Stockton lines—where we have already a number running—in order to keep engines of one type together, as far as possible. The twenty-one locomotives mentioned can hardly be intended to replace four of our make alone, as several machines by other makers are also working the North Staffordshire lines. MERRYWEATHER AND SONS.

Greenwich-road, London, April 4th.

PATENT LAW REFORM.

SIR,—The Government Bill is a step in the right direction, but it does not go far enough. It does not offer sufficient inducement to skilled workmen to make their work a study, and give to the world the benefit of their experience. They have their ideas, and they keep them in the hope of sometime making something of them; but they pass away, and in most cases their treasure—for such it must be considered—is buried with them. It is easy for some of them to invent; but if they try to make a penny out of their invention then their difficulties and troubles begin; and if they can do nothing with their invention except putting it under a bushel, whose loss is it? What is milling in England at present? Nothing; we simply cannot compete. What is the Lancashire cotton trade? I could put my finger on inventions that would revolutionise both; so I think. But one man mentions his idea to the foreman, and he goes and patents it; another is asked by a manufacturer how he would do so-and-so, and the manufacturer goes and patents his suggestion at once—no acknowledgment in either case. I can give the names. So long as this abuse is perpetuated, so long improvement will be held in check. The crude idea, whether of the rich manufacturer or of the poor workman, wants protecting for a sufficient time with as little expense as possible, so as to enable even a pedlar to patent a pin. If the rich man neglects to secure his idea, it will be folly of which he will hardly be guilty a second time. But it is the pence man who needs taking care of; the pounds will take care of themselves. In doing him justice we may be sure that no injustice will be done to anyone else. So little inducement is there at present, that one workman said to me, "Before I'd spend my money on an experiment, I'd drink it." Another whom I well know oft says to himself—

> Invention is an art, or perhaps a game,
> By which one hopes for wealth; another, fame.
> Just as the weary man beholds his prize,
> Another snatches it before his eyes.
> Invention, goddess of advancement, we
> Devote our time and talents not to thee;
> For, let us love and serve thee as we may,
> Poor is our anxious lot, and poorer still our pay.

But my belief is that the goddess never intended her votaries to serve for nought; and that if human regulations did not stand in the way they would get their dues, to the great advantage of all who in any way profit by invention. EDWARD HOYLE.

Pleasant View, Todmorden, April 2nd.

SIR,—Having had many years' experience in patents and inventions, I venture to trespass upon your space to make some remarks upon the Government New Patent Bill. To commence with the fees, few will find fault with the preliminary ones of £1 and £3, also making the fees payable the fourth year instead of the third is a step in the right direction; but as regards keeping the second and third fees at the old figures—viz., £50 and £100—I most emphatically protest against such a course; indeed, I will go further and say that if the Government is not prepared to offer anything better than the retention of these oppressive fees they had better leave the Bill alone. In the first place, seeing the large surplus revenue yielded by the Patent-office, there is no financial necessity for keeping to the old figures; and in the next place, I am prepared to prove that these prohibitive fees are a positive bar, not simply to the inventors of the working class, but even to men whose means are far more ample.

Irrespective of the question of means, it should be borne in mind that but a small percentage of even good patented inventions yield profitable results, from various causes, such as the competition of kindred patents, limited sphere of application, prejudice, and many other reasons. Again, it is well known by those who have brought out successful patents that it is frequently necessary to patent fresh additions and improvements developed in practically carrying out an invention. I have myself had to maintain five patents for an invention and its development; so in such a case it is not a mere matter of £150 to cover the second and third fee, but of £750 spread over a year or two longer. Some years ago I devised an effective improvement upon an existing patent and offered it to the patentee; but, while fully acknowledging the value of my invention, he could not entertain it, simply because he had already got three patents to maintain. Now, if he could only have secured the patent for an inclusive amount of, say, £20 or £30, he would most willingly have taken it up and paid me a good consideration for it.

It would occupy too much space to instance numerous cases where nothing but the high fees prevented people from securing really good inventions, and after a few years they have had the mortification of seeing their identical inventions patented and successfully brought out by others. I consider that the outside charge for the fourth year's fee should not exceed £10, and the seventh year's fee should not exceed £20; this would bring the total amount of fees to £34. This would still leave the total cost of a British patent at many times more than that of an American patent. The increase of the period of the provisional protection is a much-needed step, because the existing period is quite inadequate, being practically only four and a-half months before it is necessary to give notice to proceed.

With regard to the duration of a patent I am decidedly of opinion that fourteen years is too short. It is a well-known fact that it is rarely that an inventor can develope and get an invention taken up in less than three years, frequently it is more than double this period, leaving only seven years to reap any profit from it; therefore twenty years would only be a fair and reasonable duration, beyond which no extension need be granted. Respecting the question of searching to see that one does not inadvertently patent an invention which has already been patented by some one else, the existing state of things is most unsatisfactory, and no Patent Bill can be considered complete which does not embrace some remedy. It cannot be expected that an inventor can wade through all the blue books to ascertain whether he has been anticipated. If a man can afford to pay from £5 to £20—which the majority of patentees perhaps cannot—to a good firm of patent agents, he can have a search made and stand a fair chance of ascertaining what has already been done. I have adopted this course, and in two cases have thus been saved from throwing my money away in obtaining a valueless patent. Upon another occasion by having a search made it stopped my entering into an agreement with an inventor, as I found out to his dismay that his identical invention had already been patented some years before.

Now I contend that what a good patent agent can do, an efficient staff of searchers could do much better and far more economically, and for which purpose certain moderate fees could be charged, and even if these fees did not cover the cost of maintaining this staff the revenue of the Patent-office would be quite able to bear a part of the expense. If after such search the would-be patentee is shown that he has been anticipated, and he still persists in proceeding with his patent, he has only himself to blame for throwing his time and money away.

In conclusion, permit me to ask the framers of this Bill why inventors—who are at last slowly becoming recognised as benefitting the community at large—are still to be singled out and taxed in order to make a large surplus revenue for the Patent Department, and swell the Chancellor of the Exchequer's Budget? I further should be glad to know why is it one man who writes a book, which is practically the fruit of his brains, can secure a copyright for a trifling sum, while another man who creates an invention—which is equally the fruit of his brains—should be saddled with such an altogether disproportional tax. A. L. G.

London, April 4th.

THE SMOKE ABATEMENT EXHIBITION.

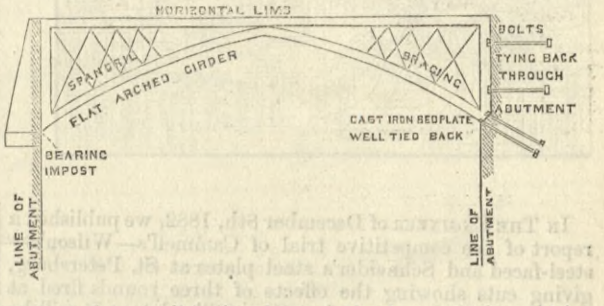
SIR,—I have read with much satisfaction your quotations from my letter, and your very proper comments. Mr. D. K. Clark, in his reply, is wrong on several points. Chimneys are still generally constructed 14in. by 9in. This allows of the gentle ascent of a column of air, sufficient in volume to carry off the foul products, and of any kind of grate to be used without frequent chimney sweeping. Boys used to climb chimneys, not men, unless they were remarkably small. Chimneys or flues, 9in. by 9in., or 9in. in diameter, are very rarely used. When they are, the owner or occupier has to use the most contracted forms of grate. It is the fire-places below the chimneys that are contracted, not the chimneys themselves. Chimneys at top are never throttled by experienced men, and to such men the gimcrack contrivances sometimes used are a subject of derision or of indifference. The aperture at top should always be equal to the aperture below when the register door is thrown open. A suitable size is a diameter of 10in. for ordinary fire-places, and 11in. or 12in. for large fire-places and kitchens. Chimney-pots are sometimes too small, and the occupants of the houses have therefore to put up with smoky chimneys, or close and stuffy rooms, in unblissful ignorance of the cause. Many years ago 6in. drain pipes were used for flues in a large metropolitan workhouse, but they had all to be removed and proper chimneys constructed at the expense of the unfortunate ratepayers. Mr. Clark himself was suspicious of something being wrong, as he expressed it to me, when my own grate was "tested." However, another little mistake has just been discovered. It appears by a report published in the *Sanitary Record* that one of the fire-places for domestic use selected for public approval emitted air for two hours at from 380 deg. to 440 deg., and that the velocity of discharge of the heated air averaged 120ft. per minute during the trial, making a volume of 13,000 cubic feet of heated air delivered per hour. Such temperature is vastly in excess of what is now used in the hot rooms of Turkish baths, and fit only for a baker's oven.

I would quote extracts from letters to me by Captain Douglas Galton, Dr. Siemens, and Dr. Alfred Carpenter, if my statement respecting them was seriously impugned.

Ravenstower, Ravenscourt Park, W., April 4th. FREDERICK EDWARDS.

BRACED IRON ARCHES.

SIR,—I remember, a short time since, some letters and correspondence appeared in your paper concerning the strains on crane posts, which was highly interesting until it became too mathematically complicated for ordinary individuals, and was at last cut short by a very simple and able explanation and diagram by Mr. Bidder. There appeared to be some doubt as to the calculation of strains in braced iron arches, and I know of no work treating of the strains in cast iron girders of the same form, cast either in one piece or bolted together at the centre. Rankine himself says, while on the subject of "Braced Iron Arches," page 569, that "the exact determination of the state of stress at different points becomes a problem of almost impracticable complexity." This is when the rib is continuous at the crown, but in all small-span bridges which have come under my notice the rib is continuous at the crown, and therefore the remark applies. He then gives an approximate solution, which I confess is beyond me. I have no doubt the problem is excellently solved in other works, but I would like to see some of your scientific and mathematical, but at the same time practical, readers show simply, and without employing calculi, &c., how we are to arrive at the sectional area of the upper and lower flanges at centre and quarter span of girders having a horizontal limb to carry transoms, roadways, &c., and a flat arched girder beneath to



receive and transmit to the abuments the strains which would be received by the lower flange and web if the girder was of the proper proportionate depth. I believe that the various members of girders of this sort bear a certain proportion to each other, which varies but little. Again, how do we arrive at the stresses on the spandril bracing, and consequent sectional area of bars in the case of built girders of wrought iron? I should also like to hear some opinions as to the fixing the girder at the ends. Is it better to give it a horizontal bearing as in ordinary girders, as at A in sketch, or to spring it off a cast iron bed-plate at right angles to the flanges, firmly bolted back through the abutment, as at B? And lastly, how does temperature affect compound girders of this sort, and what allowance should be made for it in girders of short spans, say up to 100ft? J. C. C.

April 4th.

DESCRIPTION OF A CIVIL ENGINEER.

IT is a rather curious fact that the description of a civil engineer which was written by Tredgold, and has in part been so frequently quoted, has never been given in full, except in the address of Mr. C. Hutton Gregory, C.M.G. It was written by Tredgold when an honorary member of the Institution of Civil Engineers, at the request of the Council, and is as follows:—

"Civil engineering is the art of directing the great sources of power in nature for the use and convenience of man; being that practical application of the most important principles of natural philosophy which has, in a considerable degree, realised the anticipations of Bacon, and changed the aspect and state of affairs in the whole world. The most important object of civil engineering is to improve the means of production and of traffic in states, both for external and internal trade. It is applied in the construction and management of roads, bridges, railroads, aqueducts, canals, river navigation, docks, and storehouses, for the convenience of internal intercourse and exchange; and in the construction of ports, harbours, moles, breakwaters, and lighthouses; and in the navigation by artificial power for the purposes of commerce.

"Besides these great objects of individual and national interest, it is applied to the protection of property where natural powers are the sources of injury, as by embankments for the defence of tracts of country from the encroachments of the sea, or the overflowing of rivers; it also directs the means of applying streams and rivers to use, either as powers to work machines, or as supplies for the use of cities and towns, or for irrigation; as well as the means of removing noxious accumulations, as by the drainage of towns and districts to prevent the formation of malaria, and secure the public health. This is, however, only a brief sketch of the objects of civil engineering, the real extent to which it may be applied is limited only by the progress of science; its scope and utility will be increased with every discovery in philosophy, and its resources are unlimited, and equally so must be the researches of its professors.

"The enterprising Hollanders towards the close of the sixteenth century first separated civil engineering from architecture, under the title of hydraulic architecture; their example was followed in France towards the end of the seventeenth century, and soon afterwards was systematised in the great work of Belidor on "Hydraulic Architecture."

"One of the great bases on which the practice of civil engineering is founded is the science of hydraulics; every kingdom, every province, every town has its wants, which call for more or less acquaintance with this science. Water, which is at once the most useful of the necessaries of life, and the most dangerous element in excess, when limited by the laws of this science is rendered the best of servants; the rolling cataract which spends its powers in idleness may be directed to drain the mine, to break the ore, or be employed in other works of labour for the use of man; the streams are collected and confined in canals for inland traffic; harbours are formed to still the raging of the waves of the ocean, and offer a safe retreat to the storm-driven mariner; and ports are provided with docks, to receive the riches of the world in security—hence arose the term hydraulic architecture; but it was too limited, the various applications of water had rendered the natural supplies inadequate to the wants of man, till he discovered that, combined with heat, it formed a gaseous element endued with energies not less powerful than the falling cataract; its steam, confined and directed by science, became a new source of power, which in a few years altered and improved the condition of Britain, and we are every day witnessing new applications, as well as the extension of the older ones to every part of the globe."

This description appeared only in an abridged form in the charter. The description is remarkably comprehensive, though it does not now embrace all the fields of engineering. It is, however, of much interest, and will no doubt be referred to at the annual banquet of the Institution which takes place to-morrow.

THE GOVERNMENT PATENT BILL.—A paper "On the Government Patent Bill" will be read by Mr. H. Trueman Wood at the meeting of the Society of Arts on the 18th inst.; Mr. R. G Webster, Q.C., in the chair.

EFFECTS OF SHOT ON STEEL-FACED PLATES AT ST. PETERSBURG.

Fig. 1.

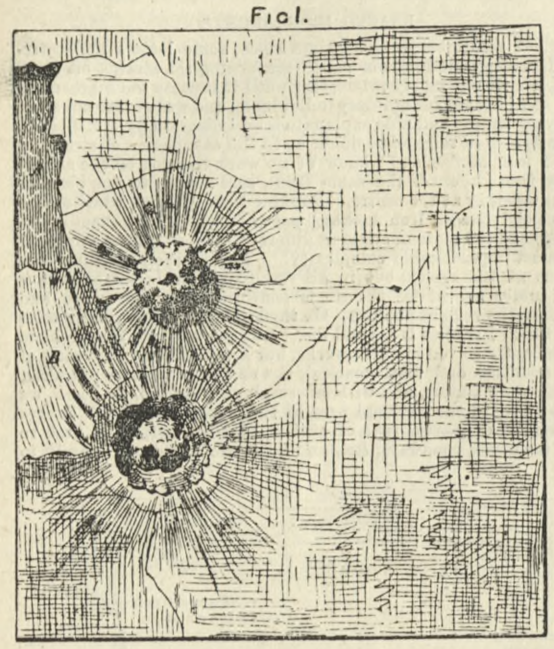


Fig. 2.

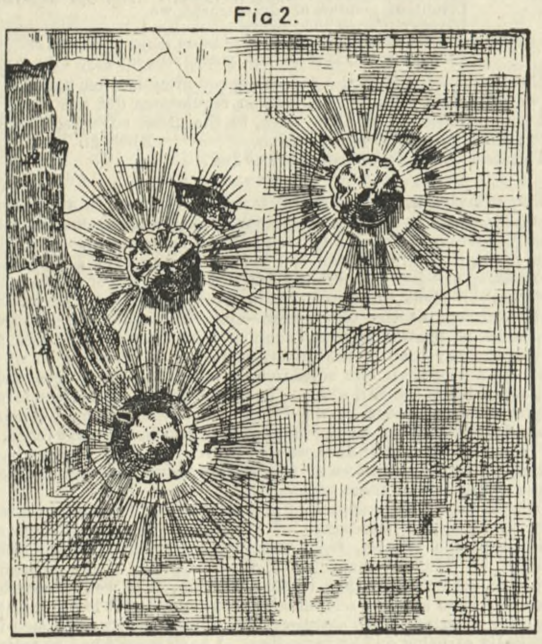
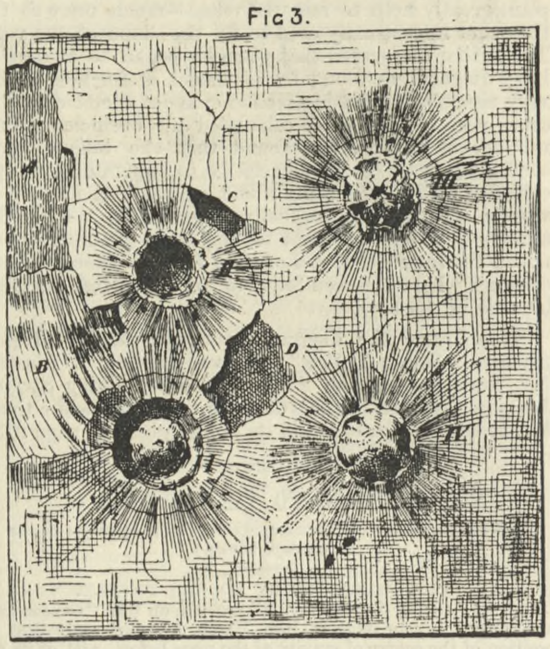


Fig. 3.



In The Engineer of December 8th, 1882, we published a report of the competitive trial of Cammell's—Wilson's—steel-faced and Schneider's steel plates at St. Petersburg, giving cuts showing the effects of three rounds fired at Schneider's, and one round at Cammell's plate. It will be there seen on reference that Schneider's plate was quite broken up in three rounds. Cammell's had borne one round very well, and apparently a second one also, but this latter result could only be judged of by the appearance of the back, the plate, like those at Spezia, having been insufficiently held up by bolts, and having become dislodged and fallen on its face. We have now to report the further trial of Cammell's plate. The first round both with Schneider and Cammell had been fired with a chilled 11in. 553½ lb. shot, and 132 lb. charge—English weight—striking with a velocity of about 1506ft. per second. This amounts to 8704 foot-tons energy, and a power of perforating 16·3in. of iron. Subsequent rounds were fired with the same kind of projectile, but with a reduced charge of 81 lb. of powder, giving a velocity of about 1167ft. with 5228 foot-tons energy, and 12·21in. of perforation through iron. The second round at Cammell's plate was found on raising the plate to have produced the effects shown in Fig. 1, striking at the point of impact II. in figure, and producing hair surface cracks chiefly concentric, and stripping a piece of plate off the portion marked A, 5in. in thickness. This effect is attributed by the makers to imperfect welding in the iron a little behind the steel face, the union of iron and steel occurring at 4in. not 5in. depth. A portion of steel, B in figure, about 1½in. to 3in. thick, was also detached. The back showed ⅝in. bulge in rear of point of impact, but no cracks anywhere, and no perceptible bulge opposite point of impact II. The timber backing was uninjured, and the projectile was broken up small.

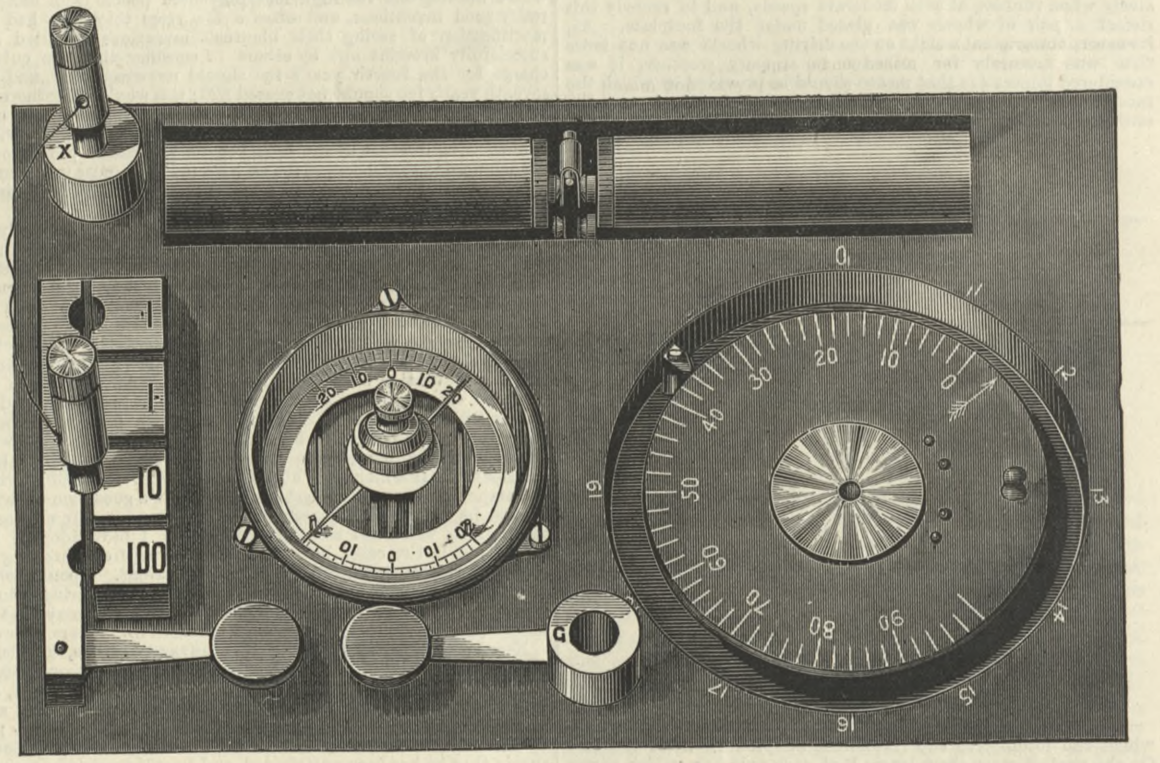
On March 8th, 1883, the firing was renewed at Cammell's plate with charge and projectile as in round two. The line of fire, however, was 12 deg. with the direct or normal line of impact. The effects are shown in Fig. 2, *vide* point III. The projectile broke up with very little effect, viz., one concentric and a few fine radial hair cracks. Another small piece of face at C was detached. The back showed no damage, and the bolts all held.

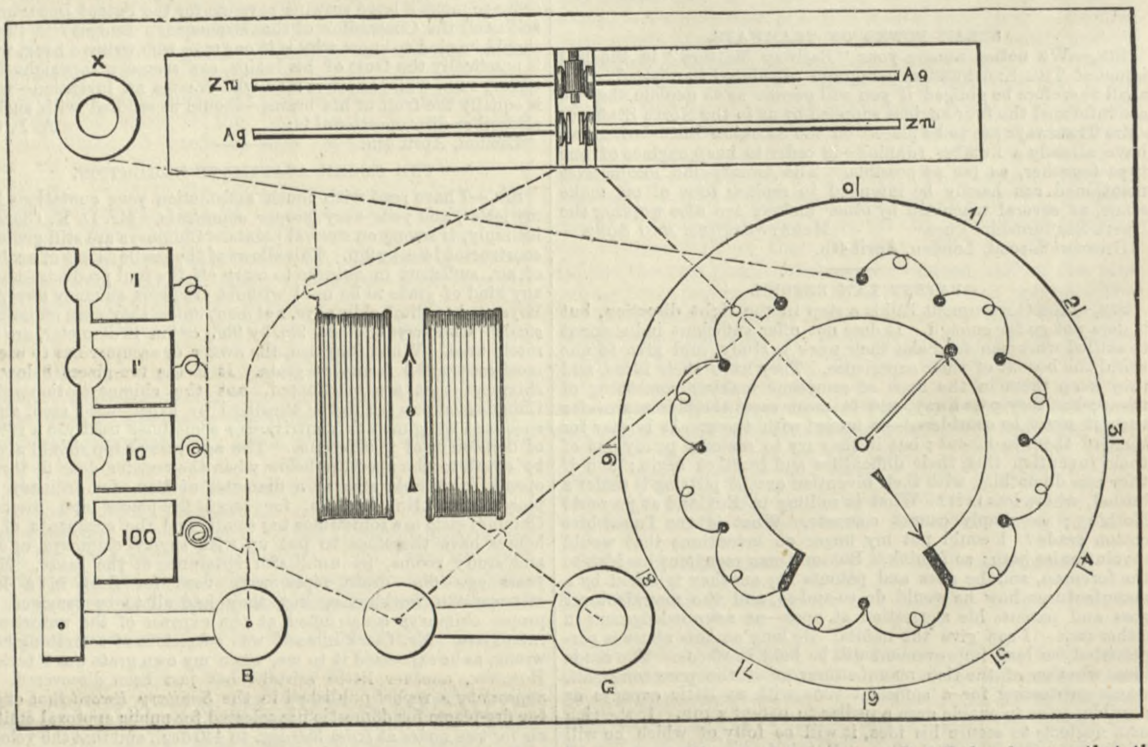
Round four was fired under the same conditions as round three. The effects are shown in Fig. 3, the shot breaking up with very little effect, especially considering the blows the plate had already experienced. Three small radial hair cracks were developed. The right-hand upper bolt was driven out, and a small piece of steel face at D dislodged. The point of No. II. shot now fell out, showing an indent of 4½in. in depth in the plate. We must congratulate Messrs. Cammell on the great success of this plate, which, we believe, is to be still further tried. The most satisfactory feature in the result is, in our judgment, the circumstance that foreign chilled projectiles were employed. Similar success has been before obtained against our own chilled shot, as in the instance reported last year—*vide* The Engineer, August 11th, 1882. Foreign chilled shot, however, have lately appeared to produce more effect against steel-faced armour than our own in some instances. It is highly satisfactory, then, to have this result to record when the trial was made with shot that succeeded in breaking up Schneider's steel plate, as reported in The Engineer of Dec. 8th last.

BLACKBURN'S PORTABLE TESTING APPARATUS.

The testing apparatus which we herewith illustrate has been designed by Mr. Blackburn, and manufactured by Messrs. Clark, Muirhead, and Co., for the use of electrical engineers, and especially those engaged in electric light work. Our illustrations are full size, the apparatus being placed in a small box, so that it will be seen to be really portable. The instrument comprises (1) a small battery consisting of two chloride of silver cells joined up in series, shown above the galvanometer in the engraving; (2) a galvanometer; and (3) a number of resistance coils. A series of eleven coils is arranged around the circumference of a circle, the contact pieces being placed on a movable turntable at the points 0 and 100. Around the edge of the turntable, between these contacts, is a platinum wire having a resistance equal to the resistance of two coils. Any portion of this resistance can be brought finally into the circuit by a movable contact piece which is connected to one pole of the battery, as shown in the plan of connections. This contact piece, in top figure, is shown at the thirty-sixth division of the resistance. Another series of coils having respectively the resistance marked on the brass heads from 1 to 100 ohms is arranged to the left of the galvanometer. The unknown resistance is joined to two loose plugs, one plug being placed at X, the other at the numbered block which most nearly approaches the supposed value of the resistance to be tested. We have shown this plug placed at the block marked 10. When the instrument is to be used as a detector only, the loose plugs are placed in one of the blocks marked X and the other at G. The galvanometer needle is astatic, and suspended by a silk fibre. The battery key is shown at B, the key opposite being that of the galvanometer. The instrument is said to measure with fair accuracy between ·005 and 2000 ohms, and the arrangement of the double turntable scale connected with the series of eleven resistance coils, gives a very wide range of adjustment for very small measures of difference of resistance. The reading of the galvanometer may thus be very exact, and an observer may always insist on definite indications, although the angular range through which it moves is under 45 deg. on either hand from zero. It will thus be seen that the instrument is exceedingly handy for most of the measurements required in electric light work. A pamphlet of instruction is issued with each instrument.

PORTABLE ELECTRICAL RESISTANCE TESTER.





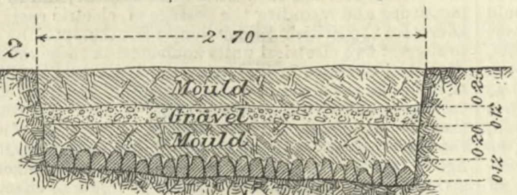
ROADS IN SWITZERLAND.

(For description see page 271.)

Fig 1.

Roman road between Avenches and Petenisca near Kallnach. Post district Aarberg.

Fig 2.



Roman road between Petenisca and the Jura over Mett in Längholz.

Roman road on the southern slope of the Septimer ¼ hour from the Monastry Ruins

Elevation

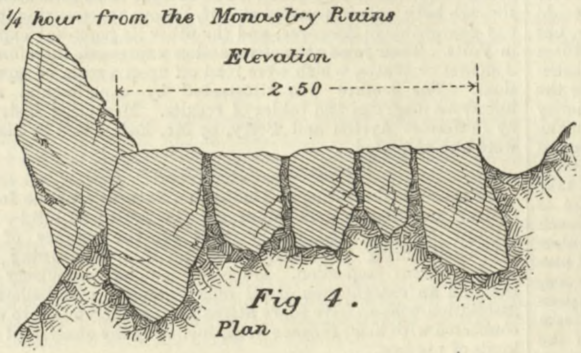


Fig 4.

Plan

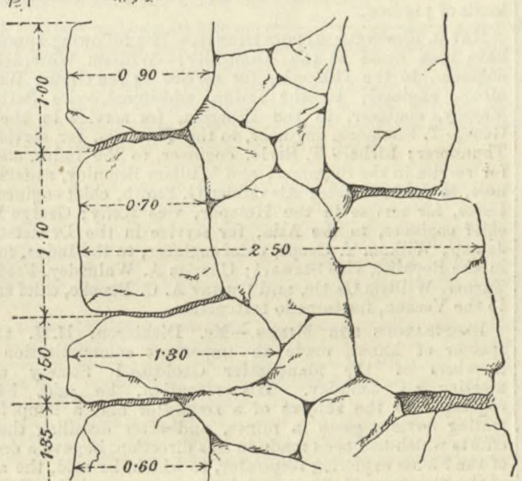
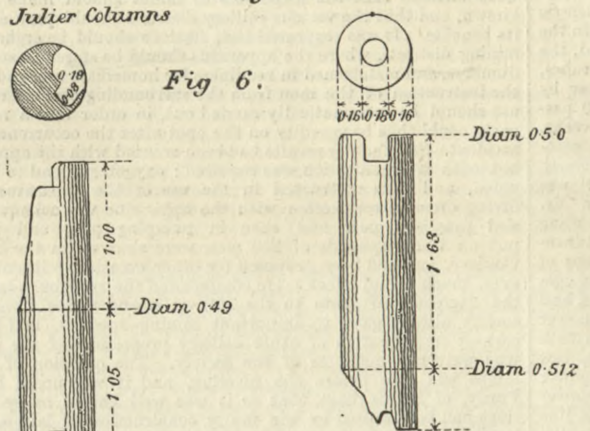


Fig 5. Julier Columns

Julier Columns

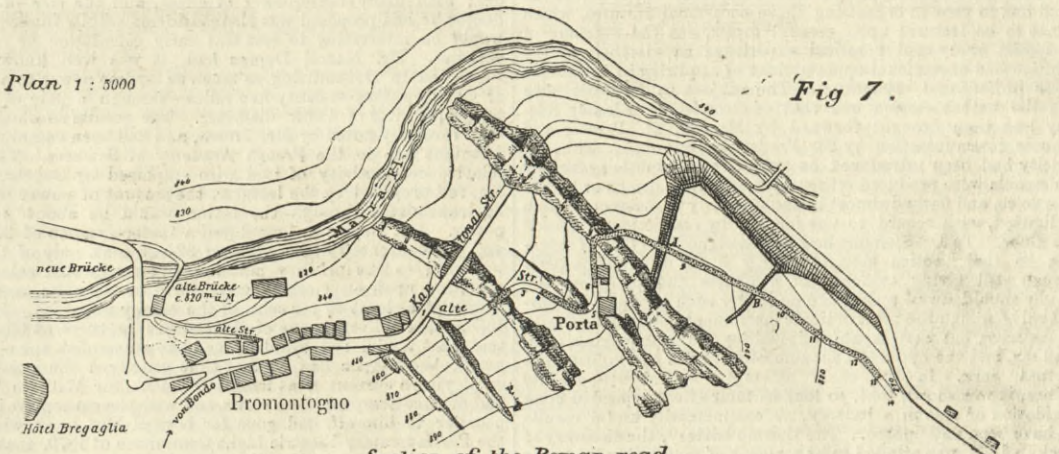
Fig 6.



Ravine near Promontogno in Bergell. Sketch of the Roman Rd & of the old Bridge.

Plan 1 : 5000

Fig 7.



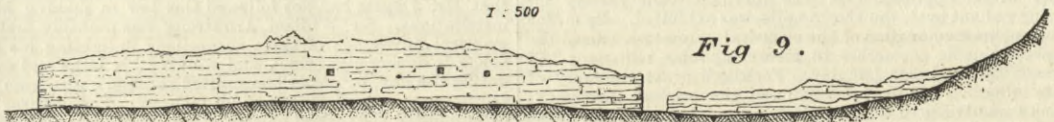
Section of the Roman road.

Fig 8.

Retaining wall at A.

1 : 500

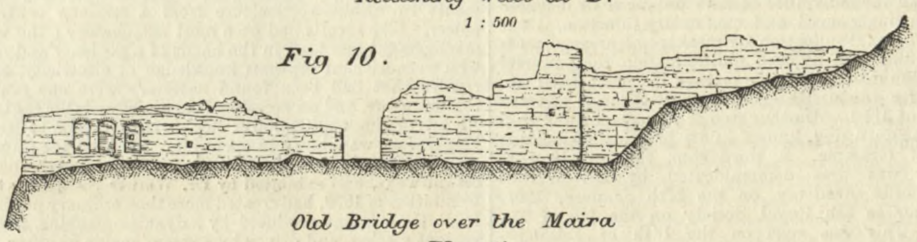
Fig 9.



Retaining wall at B.

1 : 500

Fig 10.



Old Bridge over the Maira
Elevation.

Section A.B.

Fig 11.

Section thro' centre.

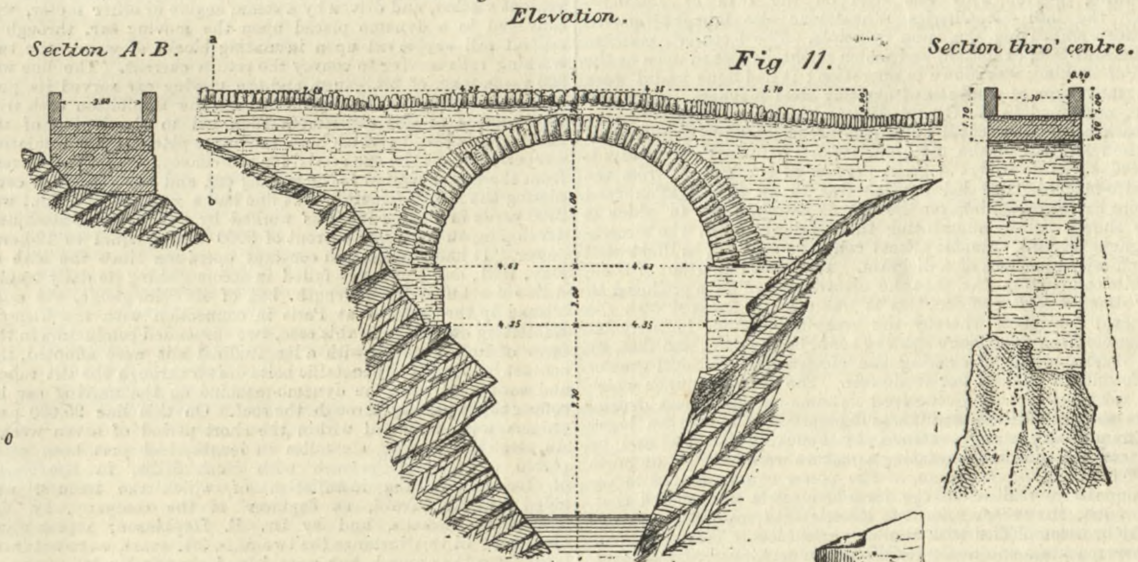
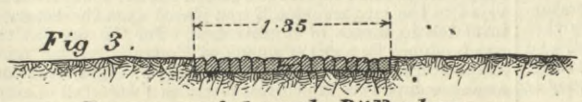


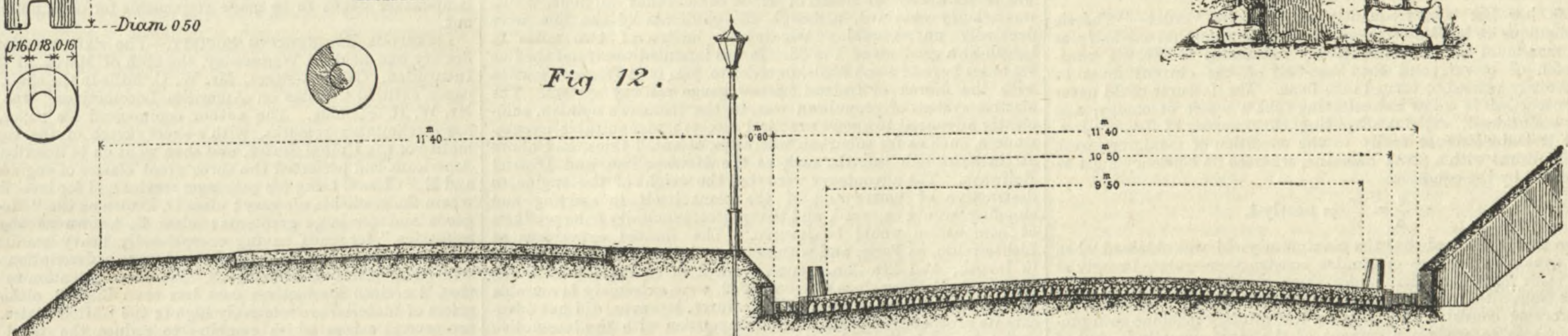
Fig 3.



Roman road towards Büttenberg.

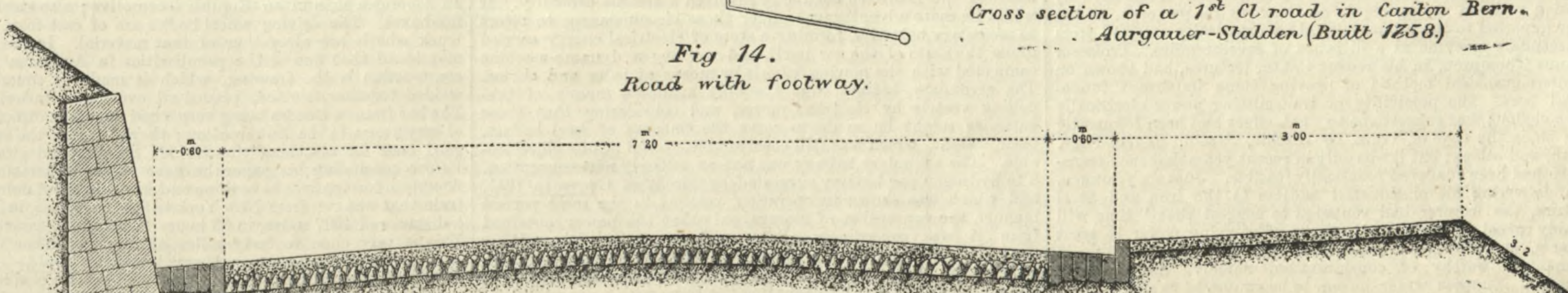
Fig 13.

Fig 12.



Cross section of a 1st Cl road in Canton Bern.
Aargauer-Stalden (Built 1758).

Fig 14.
Road with footway.



Masstab 1 : 50. 0,02 = 1 Met

THE INSTITUTION OF CIVIL ENGINEERS.

THE ELECTRICAL TRANSMISSION AND STORAGE OF POWER.

THE third of the series of six lectures on the applications of electricity was delivered on Thursday evening, the 15th of March, by Dr. C. William Siemens, F.R.S., M. Inst. C.E., on the above subject. The following is an abstract of the lecture:—

Dr. Siemens, in opening the discourse, adverted to the object the Council had in view in organising these occasional lectures, which were not to be lectures upon general topics, but the outcome of such special study and practical experience as members of the Institution had exceptional opportunities of acquiring in the course of their professional occupation. The subject to be dealt with during the present session was that of electricity. Already telegraphy had been brought forward by Mr. W. H. Preece, and telephonic communication by Sir Frederick Bramwell. Thus far electricity had been introduced as the swift and subtle agency by which signals were produced either by mechanical means or by the human voice, and flashed almost instantaneously to distances, which were limited, with regard to the former, by restrictions imposed by the globe. To Dr. Siemens had been assigned the task of introducing to their notice electric energy in a different aspect. Although still giving evidence of swiftness and precision, the effects he should dwell upon were no longer such as could be perceived only through the most delicate instruments human ingenuity could contrive, but were capable of rivalling the steam engine, compressed air, and the hydraulic accumulator, in the accomplishment of actual work. In the early attempts at magneto-electric machines, it was shown that, so long as their effect depended upon the oxidation of zinc in a battery, no commercially useful results could have been anticipated. The thermo battery, the discovery of Seebeck in 1822, was alluded to as a means of converting heat into electric energy in the most direct manner, but this conversion could not be an entire one, because the second law of thermo-dynamics, which prevented the realisation as mechanical force of more than one-seventh part of the heat energy produced in combustion under the boiler, applied equally to the thermo-electric battery, in which the heat, conducted from the hot points of juncture to the cold, constituted a formidable loss. The electro-motive force of each thermo-electric element did not exceed 0·036 of a volt, and 1800 elements were therefore necessary to work an incandescent lamp. A most useful application of the thermo-electric battery for measuring radiant heat, the thermo pile, was exhibited. By means of an ingenious modification of the electrical pyrometer, named the bolometer, valuable researches in measuring solar radiations had been made by Professor Langley. Faraday's great discovery of magneto induction was next noticed, and the original instrument by which he had elicited the first electric spark before the members of the Royal Institution in 1831 was shown in operation. It was proved that although the individual current produced by magneto induction was exceedingly small and momentary in action, it was capable of unlimited multiplication by mechanical arrangements of a simple kind, and that by such multiplication the powerful effects of the dynamo machine of the present day were built up. One of the means for accomplishing such multiplication was the Siemens armature of 1856. Another step of importance was that involved in the Pacinotti ring, known in its practical application as the machine of Gramme. A third step, that of the self-exciting principle, was first communicated by Dr. Werner Siemens to the Berlin Academy, on the 17th January, 1867, and by the lecturer to the Royal Society on the 4th of the following month. This was read on the 14th of February, when the late Sir Charles Wheatstone also brought forward a paper embodying the same principle. The lecturer's machine which was then exhibited, and which might be looked upon as the first of its kind, was shown in operation; it had done useful work for many years as a means of exciting steel magnets. A suggestion, contained in Sir Charles Wheatstone's paper, that "a very remarkable increase of all the effects, accompanied by a diminution in the resistance of the machine, is observed when a cross wire is placed so as to divert a great portion of the current from the electro-magnet," had led the lecturer to an investigation read before the Royal Society on the 4th of March, 1880, in which it was shown that by augmenting the resistance upon the electro-magnets 100-fold, valuable effects could be realised, as illustrated graphically by means of a diagram. The most important of these results consisted in this, that the electro-motive force produced in a "shunt-wound machine," as it was called, increased with the external resistance, whereby the great fluctuations formerly inseparable from electric-arc lighting could be obviated, and that, by the double means of exciting the electro-magnets, still greater uniformity of current was attainable. The conditions upon which the workings of a well-conceived dynamo-machine must depend were next alluded to, and it was demonstrated that when losses by unnecessary wire resistance, by Foucault currents, and by induced currents in the rotating armature were avoided, as much as 90 per cent., or even more, of the power communicated to the machine were realised in the form of electric energy, and that, *vice versa*, the reconversion of electric into mechanical energy could be accomplished with similarly small loss. Thus, by means of two machines at a moderate distance apart, nearly 80 per cent. of the power imparted to the one machine could be again yielded in the mechanical form by the second, leaving out of consideration frictional losses, which latter need not be great, considering that a dynamo-machine had only one moving part well balanced, and was acted upon along its entire circumference by propelling force. Jacobi had proved, many years ago, that the maximum efficiency of a magneto-electro engine was obtained when

$$\frac{e}{E} = \frac{w}{W} = \frac{1}{2}$$

which law has been frequently construed by Verdet—"Théorie Mechanique de la Chaleur"—and others, to mean that one-half was the maximum theoretical efficiency obtainable in electric transmission of power, and that one-half of the current must be necessarily wasted or turned into heat. The lecturer could never be reconciled to a law necessitating such a waste of energy, and had maintained, without disputing the accuracy of Jacobi's law, that it had reference really to the condition of maximum work accomplished with a given machine, whereas its efficiency must be governed by the equation

$$\frac{e}{E} = \frac{w}{W} = \text{nearly } 1.$$

From this it followed that the maximum yield was obtained when two dynamo-machines—of similar construction—rotated nearly at the same speed, but that under these conditions the amount of force transmitted was a minimum. Practically the best condition of working consisted in giving to the primary machine such proportions as to produce a current of the same magnitude, but of 50 per cent. greater electro-motive force than the secondary; by adopting such an arrangement, as much as 50 per cent. of the power imparted to the primary could be practically received from the secondary machine at a distance of several miles. Professor Silvanus Thompson, in his recent Cantor lectures, had shown an ingenious graphical method of proving these important fundamental laws. The possibility of transmitting power electrically was so obvious that suggestions to that effect had been frequently made since the days of Volta, by Ritchie, Jacobi, Henry, Page, Hjorth, and others; but it was only in recent years that such transmission had been rendered practically feasible. Just six years ago, when delivering his presidential address to the Iron and Steel Institute, the lecturer had ventured to suggest that "time will probably reveal to us effectual means of carrying power to great distances, but I cannot refrain from alluding to one which is, in my opinion, worthy of consideration, namely, the electrical conductor. Suppose water power to be employed to give motion to a dynamo-electrical machine, a very powerful electrical current will be the result, which may be carried to a great distance, through a large metallic conductor, and then be made to impart motion to electro-magnetic engines, to ignite the carbon points of electric lamps, or to effect the separation of metals from their combinations. A copper rod 3in. in diameter would be capable of transmitting 1000-horse power a distance of say thirty miles, an amount sufficient to supply one quarter of a million candle-power, which would suffice to illuminate a moderately sized town." This suggestion had been much criticised at the time, when it was still thought that electricity was incapable of being massed so as to deal with many horse-power of effect, and the size of the conductor he had proposed was also considered wholly inadequate. It would be interesting to test this early calculation by recent experience. Mr. Marcel Deprez had, it was well known, lately succeeded in transmitting as much as 3-horse power to a distance of 40 kilometres—twenty-five miles—through a pair of ordinary telegraph wires of 4 mm. diameter. The results so obtained had been carefully noted by Mr. Tresca, and had been communicated a fortnight ago to the French Academy of Sciences. Taking the relative conductivity of iron wire employed by Deprez, and the 3in. rod proposed by the lecturer, the amount of power that could be transmitted through the latter would be about 4000-horse power. But Deprez had employed a motor-dynamo of 2000 volts, and was contented with a yield of 32 per cent. only of the power imparted to the primary machine, whereas he had calculated at the time upon an electro-motive force of 200 volts, and upon a return of at least 40 per cent. of the energy imparted. In March, 1878, when delivering one of the Science Lectures at Glasgow, he said that a 2in. rod could be made to accomplish the object proposed, because he had by that time conceived the possibility of employing a current of at least 500 volts. Sir William Thomson had at once accepted these views, and with the conceptive ingenuity peculiar to himself, had gone far beyond him, in showing before the Parliamentary Electric Light Committee of 1879, that through a copper wire of only ½in. diameter, 21,000-horse power might be conveyed to a distance of 300 miles with a current of an intensity of 80,000 volts. The time might come when such a current could be dealt with, having a striking distance of about 1·2ft. in air, but then, probably, a very practical law enunciated by Sir William Thomson would be infringed. This was to the effect that electricity was conveyed at the cheapest rate through a conductor the cost of which was such that the annual interest upon the money expended equalled the annual expenditure for lost effect in the conductor in producing the power to be conveyed. It appeared that Mr. Deprez had not followed this law in making his recent installations. Sir William Armstrong was probably first to take practical advantage of these suggestions in lighting his house at Cragside during night time, and working his lathe and saw-bench during the day, by power transmitted through a wire from a waterfall nearly a mile distant from his mansion. The lecturer had also accomplished the several objects of pumping water, cutting wood, hay, and swedes, of lighting his house, and of carrying on experiments in electro-horticulture from a common centre of steam power. The results had been most satisfactory; the whole of the management had been in the hands of a gardener and of labourers, who were without previous knowledge of electricity, and the only repairs that had been found necessary were one renewal of the commutators, and an occasional change of metallic contact brushes. An interesting application of electric transmission to cranes, by Dr. Hopkinson, was shown in operation. Amongst the numerous other applications of the electrical transmission of power, that to electrical railways, first exhibited by Dr. Werner Siemens, at the Berlin Exhibition of 1879, had created more than ordinary public attention. In it the current produced by a dynamo-machine, fixed at a convenient station, and driven by a steam engine or other motor, was conveyed to a dynamo placed upon the moving car, through a central rail supported upon insulating blocks of wood, the two working rails serving to convey the return current. The line was 900 yards long, of 2ft. gauge, and the moving car served its purpose of carrying twenty visitors through the Exhibition each trip. The success of this experiment soon led to the laying of the Lichterfelde line, in which both rails were placed upon insulating sleepers, so that the one served for the conveyance of the current from the power station to the moving car, and the other for completing the return circuit. This line had a gauge of 3ft. 3in., was 2500 yards in length, and was worked by two dynamo-machines, developing an aggregate current of 9000 Watts, equal to 12-horse power. It had now been in constant operation since the 16th of May, 1881, and had never failed in accomplishing its daily traffic. A line ½ a kilometre in length, but of 4ft 8½in. gauge, was established by the lecturer at Paris in connection with the Electric Exhibition of 1881. In this case, two suspended conductors in the form of hollow tubes with a longitudinal slit were adopted, the contact being made by metallic bolts drawn through the slit tubes, and connected with the dynamo-machine on the moving car by copper ropes passing through the roof. On this line 95,000 passengers were conveyed within the short period of seven weeks. An electric tramway, six miles in length, had just been completed connecting Portrush with Bush Mills, in the North of Ireland, in the installation of which the lecturer was aided by Mr. Traill, as engineer of the company, by Mr. Alexander Siemens, and by Dr. E. Hopkinson, representing his firm. In this instance the two rails, 3ft. apart, were not insulated from the ground, but were joined electrically by means of copper staples and formed the return circuit, the current being conveyed to the car through a T iron placed upon short standards, and insulated by means of insulite caps. For the present the power was produced by a steam engine at Portrush, giving motion to a shunt-wound dynamo of 15,000 Watts = 20-horse power, but arrangements were in progress to utilise a waterfall of ample power near Bush Mills, by means of three turbines of 40-horse power each, now in course of erection. The working speed of this line was restricted by the Board of Trade to ten miles an hour, which was readily obtained, although the gradients of the line were decidedly unfavourable, including an incline of two miles in length at a gradient of 1 in 38. It was intended to extend the line six miles beyond Bush Mills, in order to join it at Dervock station with the North of Ireland narrow gauge railway system. The electric system of propulsion was, in the lecturer's opinion, sufficiently advanced to assure practical success under suitable circumstances, such as for suburban tramways, elevated lines, and above all lines through tunnels, such as the Metropolitan and District Railways. The advantages were that the weight of the engine, so destructive of power and of the plant itself in starting and stopping, would be saved, and that perfect immunity from products of combustion would be insured. The limited experience at Lichterfelde, at Paris, and with another electric line of 765 yards in length, and 2ft. 2in. gauge, worked in connection with the Zaukerode Colliery since October, 1882, were extremely favourable to this mode of propulsion. The lecturer, however, did not advocate its prospective application in competition with the locomotive engine for main lines of railway. For tramways within populous districts the insulated conductor involved a serious difficulty. It would be more advantageous under these circumstances to resort to secondary batteries, forming a store of electrical energy carried under the seats of the car itself, and working a dynamo-machine connected with the moving wheels by means of belts and chains. The secondary battery was the only available means of propelling vessels by electrical power, and considering that these batteries might be made to serve the purpose of keel ballast, their weight, which was still considerable, would not be objectionable. The secondary battery was not an entirely new conception. The hydrogen gas battery suggested by Sir Wm. Grove in 1841, and which was shown in operation, realised in the most perfect manner the conception of storage, only that the power obtained from it was exceedingly slight. The lecturer, in working upon Sir William Grove's conception, had twenty-five years ago constructed a battery of considerable power in substituting porous carbon for platinum, impregnating the same with a precipitate of lead peroxidised by a charging current. At that time little practical importance attached, however, to the subject, and even when Planté, in 1860, produced his secondary battery, composed of lead plates peroxidised by a charging current, little more than scientific curiosity was excited. It was only since the dynamo machine had become an accomplished fact that the importance of this mode of storing energy had become of practical importance, and great credit was due to Faure, to Sellon, and to Volckmar, for putting this valuable addition to practical science into available forms. A question of great interest in connection with the secondary battery had reference to its permanence. A fear had been expressed by many that local action would soon destroy the fabric of which it was composed, and that the active surfaces would become coated with sulphate of lead, preventing further action. It had, however, lately been proved in a paper read by Dr. Frankland before the Royal Society, corroborated by simultaneous investigations by Dr. Gladstone and Mr. Tribe, that the action of the secondary battery depended essentially upon the alternative composition and decomposition of sulphate of lead, which was therefore not an enemy, but the best friend to its continued action. In conclusion, the lecturer referred to electric nomenclature, and to the means for measuring and recording the passage of electric energy. When he addressed the British Association at Southampton he had ventured to suggest two electrical units additional to those established at the Electrical Congress in 1881, viz., the Watt and the Joule, in order to complete the chain of units connecting electrical with mechanical energy and with the unit-quantity of heat. He was glad to find that this suggestion had met with favourable reception, especially that of the Watt, which was convenient for expressing in an intelligible manner the effective power of a dynamo machine, and for giving a precise idea of the number of lights or effective power to be realised by its current, as well as of the engine power necessary to drive it; 746 Watts represented 1-horse power. Finally, the Watt-meter—an instrument recently developed by his firm—was shown in operation. This consisted simply of a coil of thick conductor suspended by a torsion wire, and opposed laterally to a fixed coil of wire of high resistance. The current to be measured flowed through both coils in parallel circuit, the one representing its quantity expressible in Ampères, and the other its potential expressible in Volts. Their joint attractive action expressed, therefore, Volt-Ampères or Watts, which were read off upon a scale of equal divisions. The lecture was illustrated by experiments, and by numerous diagrams and tables of results. Measuring instruments by Professors Ayrton and Perry, by Mr. Edison and by Mr. Boys, were also exhibited.

AT the annual meeting at Dudley, on Saturday, of the Institute of Iron and Steel Works' Managers, the president elect—Mr. M. Millard—congratulated the district on the absence of boiler explosions during the year, which, he said, was owing to the more frequent inspection. He recommended compulsory inspection and an examination of all men entrusted with boilers. The association wish to give more attention than heretofore to matters connected with blast furnace work, including the analysis of various kinds of pig iron.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—William Waterfield, chief engineer, to the Hibernia, for service in the Orion; William H. Moon, engineer, to the Indus, additional, vice Serle; John Moysey, engineer, to the Hibernia, for service in the Orion, George T. Simmons, engineer, to the Hibernia, for service in the Thunderer; Richard T. Serle, engineer, to the Indus, additional, for service in the Shannon; and William Bromley, assistant engineer, to the Inflexible; Alexander G. Smith, chief engineer, to the Indus, for service in the Hotspur, vice Kelly; George Whiting, chief engineer, to the Asia, for service in the Devastation, vice Jessop; William T. Coope, chief engineer, to the Indus, for service in the Royalist, vice Stewart; Charles A. Walmsley, Frederick S. Turner, William Castle, and Gustav A. C. Bencke, chief engineers, to the Vernon, for torpedo instruction.

RESPIRATORS FOR MINES.—Mr. Dickinson, H.M. Chief Inspector of Mines, made an important communication to the members of the Manchester Geological Society at their meeting on Tuesday. His attention, he said, had been requested to the subject of a respirator and a lamp for penetrating noxious gases in mines, and after detailing the various efforts which had been made in this direction, he gave a description of the Fleuss exploring respirator, to which, he said, the attention of the Secretary of State had been drawn; and the Government were anxious that the inspectors of mines should make it well known, and that the various colliery districts should participate in its benefits. It was suggested that stations should be organised in mining districts, where the apparatus should be stored in sufficient numbers, and maintained in readiness for immediate use, and where the instruction of the men from the surrounding coal mines in its use should be systematically carried out, in order that a rescuing party could thus be speedily on the spot after the occurrence of an accident. Satisfactory results had been secured with the apparatus, but with it organisation was required; oxygen gas had to be provided, and men instructed in the use of the apparatus. The diving dress in connection with the apparatus was acknowledged and practised now and then in pumping pits, and it was put on when upwards of 200 men were shut up in the Hartley Colliery, and had been proposed for other occasions without, however, much useful effect. He commended the recommendation of the Secretary of State to the earnest consideration which that society always gave to important mining subjects, and to the earnest consideration of other colliery proprietors of the district who were not members of the society. The question of safety lamps was also before the meeting, and it was urged by Mr. Purdy, of Nottingham, that as it was well known many explosions had been caused by the faulty construction of lamps, every lamp-maker ought to be made responsible for each lamp he sent out.

LIVERPOOL ENGINEERING SOCIETY.—The sixth meeting of the Society was held on Wednesday, the 28th of March, at the Royal Institution, Colquitt-street, Mr. W. C. Mills in the chair, when a paper entitled "Notes on American Locomotives" was read by Mr. W. H. Fleming. The author commenced his paper, after a few preliminary remarks, with a short sketch of the early locomotive of the United States, and then went on to describe how the Americans had perfected the three great classes of engines—C, D, and E. Class C being for passenger service and for level lines, and where the gradients are easy; class D, known as the "Mogul," for goods and for large gradients; class E, known as the "Consolidation," for roads having exceptionally heavy gradients, or a very large traffic to be hauled; and gave a description of each with their principal dimensions. He drew attention to the fact that American locomotives cost less than English, although the prices of material are relatively high in the United States. There are several causes which combine to reduce the total cost of materials employed. A larger amount of cast iron finds a place in an American than in an English locomotive; also steel tubes and fire-boxes. The driving wheel bodies are of cast iron, while the truck wheels are altogether of that material. In the details he mentioned that one of the peculiarities in American locomotive construction is the framing, which is made of square bar iron welded together, slotted, planed all over, and entirely finished. The bar frames, besides being very rigid in every direction, admit of easy access to the link motion; they form at the same time a good base for attaching the various bracket and girder plates. Before concluding his paper he gave as an illustration of what American locomotives have done and are capable of doing, the fast train that was run from New York to San Francisco, in June, 1876, a distance of 3317 miles, in 83 hours 27 minutes, including stops. This is very close to forty miles an hour, and has never been approached by any other railway run ever made. Also some exceedingly heavy freight trains, that had been hauled by a "Consolidation" engine, manufactured at the Baldwin Locomotive Works. The paper was illustrated by a number of photographs that Mr. Fleming had collected during his connection with the Brooks Locomotive Works, Dunkirk, New York State.

RAILWAY MATTERS.

THERE are 254 miles of tramways built abroad with English capital, for which £3,584,700 has been required.

THE constructed and authorised tramway mileage of the United Kingdom is nearly 400 miles, the authorised capital being about £11,000,000.

A PORTION of the line from Leominster to Steen's Bridge, on the new Worcester, Bromyard, and Leominster Railway, will be opened during this summer.

THE *Times* Berne correspondent says the Council of State has unanimously decided not to exercise for the present its right to purchase the railway lines in Switzerland.

IT is proposed to connect the Italian and Swiss Railways by an electric railway, worked by water power, and a portion, the St. Moritz, will probably be sanctioned shortly.

A TELEGRAM from Moror, published in Pesth on the 2nd inst., announces the burning of a mixed train owing to a truck containing petroleum having caught fire. The flames spread rapidly, and the whole train was destroyed.

THE system of forced ventilation by means of currents induced by jets of compressed air, devised by Mr. D. C. Green, and to which we referred last week, is being put forward as a means of ventilating the underground railway tunnels.

THE total quantity of iron rails exported in 1882 is stated in the Board of Trade returns to have been 46,532 tons, so that a remainder of 13,807 must have been left for home use. Most, if not all, of this quantity took the form of light rails for colliery purposes, the weight varying from 16 lb. to 25 lb. per yard.

THE Standing Orders Committee resolved on Tuesday unanimously that the Standing Orders should not be dispensed with in favour of the Bills prepared by the Metropolitan Board of Works and Commissioners of Sewers for the removal of the ventilators on the Embankment. Parliament will probably over-rule the decision of the committee.

THE Great Western Railway Company has issued a notice at its engine works in Wolverhampton stating that on and after the 6th inst. the works will be closed from 5.30 p.m. every Friday until 6.0 a.m. on Monday. This means a reduction of about 5¼ hours in the men's time. The Swindon and Worcester works of the same company are also making short time.

ON the 3rd inst. a Select Committee of the House of Commons passed the Bill authorising the construction of a railway commencing by a junction at Harrow with the already sanctioned Beaconsfield, Uxbridge, and Harrow Railway, passing through Hendon, and terminating by junctions with the Edgware and Highgate Branch Railway of the Great Northern Railway, and the Alexandra branch line of the same company.

A NARROW railway, 94 kilometres—58½ miles—long, and 1 metre—3ft. 3⅜in.—gauge, has lately been completed between Calais and Anvin, at a cost of only about £5000. The locomotives cost £1280, the carriages £320, and the luggage vans £146. The minimum radius of the curves is 130 metres, and the steepest gradient 1 in 66. The line is not fenced, and the level crossings only have barriers in the hamlets and villages.

A SPECIAL train from London, conveying excursionists to the Northampton Races on Tuesday, tore through the platform and entered a carriage shed at Northampton station, owing to the failure of the Clayton continuous vacuum brake. The shed was completely wrecked, some of the *débris* falling into the smoking-room of the Warwick Arms Hotel, which was full of people. Strange to say, none of the passengers or people in the hotel were injured.

A LINE of railway connecting the inland watering-place Moffatt, in Dumfriesshire, with the Caledonian system at Beatock, was opened on Monday for both goods and passenger traffic. Although it has been constructed by an independent company, it is to be worked by and has been leased in perpetuity to the Caledonian Railway. Moffatt is by this line brought within nine hours' journey from London, seven from Birmingham, six from Manchester and Liverpool, and two from Edinburgh and Glasgow.

THE accidents on American railways in December last are classed by the *Railroad Gazette* as to their nature and causes as follows:—Collisions: Rear collisions, 37; butting collisions, 25; crossing collisions, 2; total, 64. Derailments: Broken rail, 12; broken switch rod, 1; broken bridge, 3; spreading of rails, 10; broken wheel, 4; broken axle, 3; broken truck, 1; wash-out, 1; land slide, 1; accidental obstruction, 2; cattle, 1; ice, 1; rail removed for repairs, 1; misplaced switch, 13; purposely misplaced switch, 4; malicious obstruction, 1; unexplained, 18; total, 77. Boiler explosions, 2; broken connecting-rod, 1; broken tire, 1; car burned while running, 3. Grand total, 148. Six collisions were caused by trains breaking in two; six by misplaced switches; six by mistakes in train orders or neglect to obey them; two by flying switches; two by runaway engines; two by failure to use signals; one each by a wreck upon other track, by blinding snow and by fog.

THE *Railroad Gazette* record of American railway accidents last December shows for that month 148 accidents, in which 29 persons were killed and 209 injured. The list includes 64 collisions, in which 26 persons were killed and 75 injured; 77 derailments, with 3 killed and 129 injured, and 7 other accidents, in which 5 persons were injured. Twenty-eight of the killed and 80 of the injured were railroad servants, while one of the killed and 129 of the injured were passengers or others riding on the trains. Servants constituted 96·6 per cent. of the killed, 38·3 per cent. of the injured, and 45·4 per cent. of the whole number of casualties. The proportion of casualties to passengers was increased by a few accidents in which a considerable number of slight injuries to passengers are reported. In fifteen accidents one or more persons were killed; in 45 there was injury to persons, but not death, leaving 88, or 59·5 per cent. of the whole number, in which no serious injury is reported. As compared with December, 1881, there was an increase of 35 accidents, a decrease of 7 in the number killed, and an increase of 113 in the number injured.

AT the end of the past year the Canadian Pacific Railway track had been laid on the main line to a point 585 miles west of Winnipeg, and notwithstanding the severity of the winter, the work was continued throughout the month of December. Owing to the incomplete condition of the grades previously made, and the unprecedented floods, rapid progress could not be made until late in June. Grading was not undertaken until late in May, in consequence of the unavoidable delays; from that time it was continued until the middle of November, when it was terminated at a point within 50 miles of the crossing the South Saskatchewan. On the eastern section—north of Lake Superior—the track is laid from Callander to the Sturgeon River, a distance of 40 miles, and the grading is nearly completed for another 20 miles. It is expected that the line will be extended 100 miles further west during the present year. Two thousand three hundred men and 173 teams are employed on the work. On the Algoma branch, which diverges from the main line a few miles west of Wahnapitae River, and thence follows in a direct line to Algoma Mills on Lake Huron—a distance of 100 miles—the track has been laid from Algoma for 25 miles, and the grading on the remainder is so far advanced as to justify the belief that the line will be finished before the end of the coming season. This branch will afford a summer communication with the main line west of Thunder Bay, pending the completion of the Lake Superior section. One thousand and fifty men and eighty teams are now employed on this branch. Active operations have been commenced on the road from Prince Arthur's Landing eastward to Nepigon River, and it is believed that 100 miles of work will be laid in 1883. One thousand one hundred and fifty men and 100 teams are now engaged upon it. The directors state that the line will be completed from Montreal to Kamloops in 1886.

NOTES AND MEMORANDA.

DURING 1882 there was a net decrease of 183,173 tons in the quantity of coal imported into London.

THE loss by worn silver withdrawn from circulation because of deficiency in weight caused by wear last year amounted to not less than £35,000.

THE total number of puddling furnaces in operation at the end of 1882 in the United Kingdom was 4369, being 814 less than in the preceding year.

IT has been found that electric arc lamp carbons are almost perfect non-conductors until after they are baked, and their conductivity depends much on the perfection of the baking.

THE total number of persons employed in and about the mines of the United Kingdom under the Coal Mines Act was 503,987 in 1882, against 495,477 in 1881. The average output of minerals per individual employed over the year was 339 tons in 1882, and 340 tons in 1881. This includes the fireclay, ironstone, and shale, as well as the coal raised in both years.

IN a paper on waters for steam-raising Mr. W. Ivison Macadam says:—"No attempt should be made to soften water or employ anti-incrustators without first making a searching inquiry as to the nature of the waters available and the scale they may form. No special law can be laid down for the softening of water or the use of anti-incrustators; the cause of the disease must first be learned, and then the remedy may be safe and sure. To limit the materials used, by laying down a hard-and-fast law, would be to cause injury and loss to the steam user. The best results are obtained by the employment of a man of skill and the rigid working out of his suggestions."

A REPORT on the trade in champagne, or reputed champagne, has been published in Paris, which gives figures of some interest from a railway and transport point of view, apart from the other facts given. According to this, 23,000,000 bottles of champagne are exported annually in the following proportions:—Africa, 100,000 bottles; Spain, 300,000; Belgium, 500,000; Italy, 500,000; Holland, 600,000; Germany, 1,500,000; Russia, 2,000,000; England, 5,000,000; Northern America, 10,000,000. The consumption in France is valued at £2,500,000. During the last two years a considerable amount of the champagne was manufactured from Italian grapes. The exportation of grapes from Italy will be, judging from contracts made with great exporters, very large. The *Brewers' Guardian* says that wagons have been specially built in Milan to convey the grapes direct from the Italian provinces to the wine manufacturing districts of France.

ACCORDING to the report of the British Iron Trade Association, the production of puddled bar in the United Kingdom during 1882 amounted to 2,841,534 tons, against 2,681,150 tons in the preceding year, the increase being thus 160,384 tons. It is noticeable that this would be a larger increase than that which has occurred in the production of pig iron for the same period, but the figures given for 1881 in respect of the North of England are subject to the modification that they refer to manufactured iron only, while those for 1882 apply to puddled bar; and as the quantity of the latter produced in 1882 was more than 100,000 tons in excess of the make of finished iron, a nearly corresponding increase of puddled bar may be assumed for the former year. Cleveland alone produced 852,199 tons, which is nearly 200,000 tons more than South Staffordshire, the next largest producer. During the year South Wales, Yorkshire, North Staffordshire, and Shropshire, showed a decrease.

M. SILVESTRI has recorded—Bull. de la Soc. Chim., December 20th, 1882—that some years ago he found in a basaltic rock cavities filled with a liquid which partly solidified on cooling. This liquid consisted of a mixture of hydrocarbons containing 42·8 per cent. of paraffine. Its density was 0·9475 at 20 deg. On carefully studying this rock he came across other cavities, of about 1 centimetre in diameter, filled with a solid crystallised paraffine. This substance is yellowish-white, resembling wax. It melts at 56 deg., and boils at 300 deg. It is insoluble in water, almost insoluble in cold alcohol, very soluble in ether. It is almost identical with the solid paraffine contained in the liquid mentioned above. Its composition is represented by the following mean numbers:—Carbon, 84·003; hydrogen, 15·846; total, 99·849. The "Journal" of the Society of Chemical Industry remarks:—"With reference to Professor Silvestri's interesting observation of the occurrence of a paraffine in the lava from Etna, the fact may be recalled that twenty years ago Professor Roscoe extracted a waxy substance containing paraffine from the Alais meteorite."

THE following are extracts from the patent specification of Mr. F. M. Lyte for the manufacture of peroxide of lead:—"Metallic peroxides have been manufactured previously by the addition of chlorine to solutions of the soluble metallic salts, but I manufacture the peroxides by using a solution of cream of bleaching powder, to which has been added some quicklime or hydrate of lime, so as to prevent the hydrochloric acid, which is also formed during the reaction, from attacking the peroxide after it is made, and the liberation of free chlorine." "The quantities of bleach and lime used may be such that each gallon of water shall contain about 3 lb. to 3½ lb. of the raw materials, *i.e.*, of the mixture of bleach and lime." "I take a suitable tub or vessel, the contents of which can be heated by steam or otherwise, and I put into it chloride of lead in the proportion of two equivalents of chloride of lead for every two equivalents of bleaching powder which I have used. I then add boiling water of about four times the weight of the chloride of lead to be used. This quantity of water will be insufficient to dissolve the whole of the chloride of lead at once, but some portion will dissolve, and the remainder will form a magma with the solution. I then add the cream of bleach and and lime very slowly to the boiling solution of chloride of lead, stirring thoroughly during the whole time. The addition of the bleach solution causes the deposition of peroxide of lead by decomposing the chloride of lead which is in solution, and the liquor which remains immediately dissolves a further quantity of the chloride of lead which was previously undissolved, so that the action goes on continuously until all the chloride of lead has been decomposed and converted into peroxide. The peroxide is then washed with dilute nitric acid."

THE *Scientific American* gives records of a notable experiment in long distance telephoning, recently made on a new compound steel-copper wire of the Postal Telegraph Company, lately completed between New York and Cleveland, Ohio, a stretch of 650 miles. The compound wire has a diameter of $\frac{7}{32}$ of an inch, consists of a steel wire core, weighing 200 lb. per mile, that will resist a tensile strain of 1650 lb., on which copper is deposited to the extent of 500 lb. per mile, with a resistance to the electric current not exceeding $1\frac{7}{10}$ ohms. The wire has seven times greater conductivity than iron wire of equal size. It has double the tensile strength of iron wire of equal weight when strung on the lines, will last longer, permits the use of low tension currents and small batteries. Ninety per cent. of the wires now in use are No. 9 iron, with a resistance of 20 ohms per mile, and the very best are No. 6 iron, with a resistance of 10 ohms, while the compound wire to be used by this company has a resistance of only $1\frac{7}{10}$ ohms. The resistance of No. 9 iron wire on a line from New York to Chicago, 1000 miles, is over 20,000 ohms, and on a No. 6 iron wire over 10,000 ohms, and on the compound wire less than 1700 ohms, thus bringing Chicago telegraphically as near to New York as Philadelphia, and San Franciso as near as Cleveland, compared with the best wires now in use. Since this was published a telegram from New York has stated that the wire to Chicago has been completed and the messages successfully sent over the 1000 miles by it, and the transmitter of Mr. G. M. Hopkins, in which a carbon electrode floats on mercury which presses the electrode into contact with the carbon button of the diaphragm. The cable message gives the resistance as 1522 ohms, as compared with 15,000 ohms of the wire ordinarily used. It will be seen that a considerable quantity of copper is used; sufficient, in fact, to account for the result.

MISCELLANEA.

WHILE the French squadron was lying off Athens, on Tuesday, a gun burst on board the admiral's flagship. Three of the crew were killed, and two injured.

THE Bath and West of England Society will this year hold its annual show at Bridgwater, on May 28th, 29th, 30th, 31st, and June 1st. Entry forms, &c., can be obtained of the secretary, Mr. Thos. F. Plowman, Bath.

THE Netherlands Government informs intending exhibitors at the Amsterdam International Exhibition that no charge will be made for watching, sealing, permits, or other Custom-house formalities required with respect to goods sent from abroad.

LORD EDWARD CAVENDISH M.P., has agreed to act as a vice-president of the Local Reception Committee on the occasion of the visit of the Gas Institute to Sheffield in June next. The misunderstanding that arose a month ago has now been cleared away, and the Institute will receive an official welcome to the town.

IT is announced that the Peninsular and Oriental Steam Navigation Company will cease its direct service from Antwerp, and send in future only small steamers there to ship goods for London. The Cape Line will also no longer send its vessels to Antwerp. The causes of these steps being taken are said to be the refusal of subsidies on the part of the Belgian Government, and the withdrawal of the concessions relative to pilotage and lighthouse duty.

THE pier at Nice was on Tuesday completely destroyed by fire. Flames first broke out about five o'clock in the evening, and spread with great rapidity over the whole structure. Despite the promptitude with which help was procured, only the iron framework of the bridge connecting the pier with the land remains standing. The cause of the fire has not definitely transpired, but it is said that a workman on the roof of the large hall on the pier overturned a pot of tar; but this, without a fire, would not do much harm. The workmen saved themselves by jumping into the water. The loss is estimated at 5,000,000f.

AT Moscow the preparations for the Coronation are making rapid progress. For several nights the great belfry tower of iron has been splendidly illuminated by electricity by way of an experiment. No fewer than 4000 Swan incandescent lamps cover the cupola, and 120 electric lamps of Russian invention outline the cross. All the principal churches are also to be illuminated with ordinary lights from foundation to spire. The *Times* correspondent says the assistance of foreigners in the work is to be entirely dispensed with if possible, and no English illuminating or pyrotechnic firms will be employed on this occasion, as they were at the coronation of Alexander II.; but it is well known that the Swan United Company has sent a great quantity of material to Moscow. The firework displays are to be conducted by artillerists and engineers, independently of all extraneous aid.

ON Monday, at a joint meeting of the Tees Conservancy Commissioners and the Hartlepool Port and Harbour Commissioners, including Sir Joseph Pease, M.P., and Mr. Dodds, M.P., to confer on the subject of a national harbour of refuge on the north-eastern coast, it was decided that an immediate appeal be made to the Government not to come to any decisive determination as to the site of any public harbour of refuge on the north-east coast until the claims of other sites and their relative advantages over Filey have been submitted and fully considered, and that all the port and harbour authorities on the north-east coast, and the local members of Parliament, be invited to co-operate in a deputation to the Prime Minister on the subject. It was further decided that Mr. Rendle, C.E., be engaged to design the model of a harbour from Hartlepool Heugh, on the Durham coast, to Huntcliffe Foot, on the Yorkshire coast.

M. DE LESSEPS arrived on the 27th ult. at Tozeur, on the proposed Sahara Sea scheme. Soundings 73 metres deep have shown the existence of nothing but sand. The African inland sea might easily be made, with the aid of 100 excavators, representing the work of 100,000 men. M. de Lesseps has met with the best reception from the Arab soldiery and population. On the 3rd inst. he arrived at Biskra, having completed a survey of the country between Gabes and the Marsh Lakes. He declared that the soil will allow of the excavations necessary to connect the lakes with the Mediterranean, that the works will present no extraordinary difficulty, and that the concessions asked for with regard to the forest and adjoining lands will make the scheme remunerative, and wholly independent of State aid, subvention, or guarantee. M. de Lesseps telegraphed a report favourable to the projected inland sea to the French Government on the 3rd inst.

A DISASTROUS accident occurred on Saturday last in one of the factories of the Compagnie des Forges de Campagne, at Marnaval, near St. Dizier. A vertical boiler exploded at a few minutes past eight, when all the hands, having finished their first breakfast, had returned to work. The force of the explosion was terrific, the upper part of the boiler being blown through the roof of the workshop, and the bricks and masonry surrounding the boiler projected with such force against the walls that the remaining portion of the roof fell in, killing thirty-one persons and wounding about seventy others. The chief puddler, who was working at a furnace close to the boiler, escaped miraculously with only a few insignificant scratches on the hand, but curiously enough he cannot say how he reached the banks of the river Marne, where he found himself a few seconds after the explosion. Two men working by his side were killed, and his two sons, who were occupied in the foundry, are also among the dead.

THE facilities afforded by the Southampton Docks were shown on Saturday last by the North German Lloyd steamer Werra, of 5109 tons—one of the largest and latest additions to the fleet of that corporation—steaming direct into the No. 4 Dry Dock with a full cargo and some 600 passengers on board. Her repairs were effected by Messrs. Oswald, Mordaunt, and Co., and the ship was undocked on the following day. She was then placed alongside the Extension Quay, from which she sailed at mid-day on Monday, having in the meantime taken on board some 1200 tons of coal. This ship exceeds in length either of the steamers Rome and Carthage, the recent additions to the Peninsular and Oriental Company's fleet. We may add that the dry dock, which is being lengthened by the Dock Company, is 24ft. wider, and will be 50ft. longer, than that in which the Werra was docked on Saturday last, and when completed will, we believe, exceed in length on blocks and in width any graving dock in the port of London.

THE usual monthly meeting of the Meteorological Society was held on the 21st ult., at the Institution of Civil Engineers. The paper read was "Notes on a March to the Hills of Beloochistan in North-West India, in the months of May to August, 1859, with remarks on the Simoon and on Dust Storms," by Dr. H. Cook. These months may be considered as the summer of the hill country of Beloochistan, though the natives expect the weather to change soon after the fall of rain, which takes place about the end of July and beginning of August. Compared with that of the plains the climate is delightful. The actual heat is greater than in England, especially the intensity of the sun's rays, but the weather is less variable. Fruits and crops, as a rule, ripen earlier, and are not exposed to the vicissitudes of the English climate. The atmosphere is clear and pure, the air dry and bracing. Dr. Cook describes various kinds of dust storms, and considers that they are due to an excess of atmospheric electricity. With regard to the simoon, which occurs usually during the hot months of June and July, it is sudden in its attack, and is sometimes preceded by a cold current of air. It takes place at night as well as by day, its course being straight and defined, and it burns up or destroys the vitality of animal and vegetable existence. It is attended by a well-marked sulphurous odour, and is described as being like the blast of a furnace, and the current of air in which it passes is evidently greatly heated. Dr. Cook believes it to be a very concentrated form of ozone, generated in the atmosphere by some intensely marked electrical condition.

THE TOWER OF PETERBOROUGH CATHEDRAL.

(For description see page 259.)

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TO CORRESPONDENTS.

*** *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.*

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

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

VORTEX.—*A letter lies at our office for this correspondent.*

W. H. G. (Swansea).—*We believe you can obtain further information from the Secretary of the Iron and Steel Institute, Victoria-chambers, Victoria-street, Westminster.*

A. Z.—*There is no book dealing specially with, or giving very much information on, mixtures. The best you can get is Spretson's book "On Casting and Founding," published by E. and F. N. Spon.*

T. T. (Cardigan).—*There is no cement that we can recommend for the purpose. Use gutta-percha rings softened in warm water between the flanges. These will make perfect water-tight joints.*

DRAUGHTSMAN.—*In most drawing offices no wages are deducted for holidays. We regret to say, however, that this is not the universal rule. You ought to have had the question settled before you entered on your duties. Your employer is certainly not obliged to pay you in the absence of a specific agreement.*

J. V. M.—*If an action were commenced against you you would find it almost impossible to keep your secret. Your opponents probably would not have the right to inspect, but an independent person would be appointed for that purpose, and you might be searchingly cross-examined. If your invention is not an infringement why do you not patent it?*

H.—*It would be necessary to take wires of similar section and length of the different materials and measure the resistances. The conductivities are the reciprocals of the resistances. Tables of specific resistances are given in almost every elementary text-book on electricity, such as that of Professor Fleeming Jenkin, published by Longmans and Co. See "Electric Light Arithmetic," by Day, published by Macmillan and Co.*

RASPING HORNS.

(*To the Editor of The Engineer.*)

SIR,—Can any of your correspondents give me the name and address of a maker of a machine for rasping to fine chips the horns of cattle and hoofs of horses? R.

Lincoln, March 29th.

JARROW FERRY.

(*To the Editor of The Engineer.*)

SIR,—Referring to THE ENGINEER of the 30th ult., in which are published the designs of the horse and car ferry landing stage at Jarrow, permit me to inform you that the designs and the description thereof were prepared by me, and not by Mr. Tate, and that on the copies of the designs sent to you for publication my name only was imprinted thereon. I may add that Mr. Tate neither prepared the plans nor was he consulted by my Corporation on the subject. J. W. PETREE.

Borough Surveyor's-office, Jarrow, April 3rd.

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, April 10th, at 8 p.m.: Ordinary meeting. Paper to be read with a view to discussion, "The Introduction of Irrigation in New Countries, as Illustrated in North-Eastern Colorado," by Mr. P. O'Meara, M. Inst. C.E.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, April 12th, at 8 p.m., a paper will be read "On Microphonic Contacts," by Mr. Shelford Bidwell, M.A., LL.B.

INSTITUTION OF MECHANICAL ENGINEERS.—The next ordinary general meeting of this Institution will be held on Wednesday, April 11th, and Thursday, April 12th, at the Institution of Civil Engineers. The chair will be taken at three o'clock on Wednesday afternoon, and at ten o'clock on Thursday morning, the rooms of the Institution being otherwise occupied on Thursday evening. The annual dinner will be held at the Criterion Restaurant on Wednesday evening at half-past seven o'clock. The following papers will be read and discussed:—"On the Strength of Shafting when Exposed both to Torsion and End Thrust," by Professor A. G. Greenhill, of Woolwich. "On Modern Methods of Cutting Metals," by Mr. W. Ford Smith, of Salford. "On Improvements in the Manufacture of Coke," by Mr. John Jameson, of Newcastle-on-Tyne. "On the Application of Electricity to Coal Mines," by Mr. Alan C. Bagot, of London.

SOCIETY OF ARTS.—Monday, April 9th, at 8 p.m.: Cantor Lectures, "The Decorative Treatment of Metal in Architecture," by Mr. George H. Birch, A.R.I.B.A. Lecture II.—Bronze, continued—Rome, Lombardy, Germany, Hildesheim, Italy, during the Middle Ages. The culminating point during the renaissance. Ironwork—The art of the blacksmith, and the use of wrought iron in the North of Europe. Wednesday, April 11th, at 8 p.m.: Seventeenth ordinary meeting, "The Portrush Railway and the Transmission of Power by Electricity," by Messrs. Alexander Siemens and Edward Hopkinson, D.Sc. Thursday, April 12th, at 8 p.m.: Applied Chemistry and Physics Section, "The Formation of Diastase from Grain by Moulds," by Mr. R. W. Atkinson, B.Sc. Professor Charles Graham will preside.

DEATH.

On the 26th Feb., at Singapore, Straits Settlements, after four days' illness, WILLIAM FORBES ASHDOWN, C.E., of the Public Works Department, aged 26, son of the late John Ashdown, C.E., of Norfolk-street, Strand. Friends will kindly accept this intimation.

THE ENGINEER.

APRIL 6, 1883.

THE CHANNEL TUNNEL.

ON Tuesday night Mr. Chamberlain, in the House of Commons, rose to move "That a Committee of five members of this House be appointed to join with a Committee of the House of Lords, to inquire whether it is expedient that Parliamentary sanction should be given to a submarine communication between England and France; and to consider whether any or what conditions should be imposed by Parliament in the event of such communication being sanctioned, and that the correspondence with reference to the proposed construction of a Channel tunnel, presented to Parliament in 1882, be referred to the Committee." Sir Stafford Northcote moved an amendment, "That before entering upon the question whether it is expedient that Parliamentary sanction should be given to the establishment of submarine communication between England and France, and upon what conditions, if any, such sanction should be granted, it is desirable that the House should be put in possession of the views of her Majesty's Government on these subjects." The House divided, and the amendment was rejected by a majority of 32, and Mr. Chamberlain's motion was carried by a majority of 34, the numbers being 106 for the Government and 72 against. So far as can be seen, the Government have no fixed opinion in the matter. Mr. Chamberlain, in his speech, repeated the history of the undertaking in so far as it was mixed up with Government, and Sir Stafford Northcote offered some explanations. The policy of handing the whole question over to committee after committee is not new, and possesses some advantages. In the first place, while the committees are at work the Channel Tunnel can make no progress; in the second place, the Government disarms criticism. It is well known that if a given subject is only referred often enough to committees, in time any required decision can be obtained, for it is extremely improbable that nothing but adverse or favourable decisions will be pronounced by committee after committee. It is true that committees have already condemned the Channel Tunnel scheme; but if only Sir Edward Watkin is pertinacious enough—and who can doubt this—a committee must as last be appointed which will side with him. Then is the time to strike, and remove the whole affair out of the ken of committees. It has been said that if only a man could be tried often enough, a jury would at last be found to convict him. In the same way, if only the Channel Tunnel scheme can be tried often enough, a verdict in its favour will perhaps be pronounced. That will be Sir Edward Watkin's opportunity and England's danger.

We shall say nothing at this moment concerning the military aspect of the question. There are two other points which deserve consideration—the first is the influence which its presence may have on our trade; the second is the method of working it. Captain Aylmer, Member of Parliament for Maidstone, called attention to the first question in the debate on Mr. Chamberlain's motion on Tuesday night. He raised a point which has not been noticed before. The effect of the tunnel would be, he said, to draw away the whole trade of the East from our own ports to those of France and the Mediterranean. Now, we certainly cannot accept Captain Aylmer's views without much qualification, but that he was right in a measure there can be no doubt. So long as there is only one tunnel, and that tunnel is worked with difficulty, the rates charged for the conveyance of merchandise through it must be prohibitive. But if Sir Edward Watkin be right, and a tunnel can be made easily, certainly, quickly, and cheaply, then instead of one we shall have half-a-dozen—just in the same way that the first Atlantic cable was followed by several others. It is simply out of the question that a single tunnel should enjoy the monopoly of traffic between this country and the Continent, save under the conditions that the first tunnel was made at great expense, with much risk, and slowly, and could not be worked with ease. For the sake of argument let us suppose that Sir Edward Watkin is right, and it follows that not one but several tunnels will exist in a few years. We have no doubt the existence of these tunnels would to some extent modify for the worse our eastern trade. There can be no question that much that is now carried by ship up the Mediterranean, through the Straits of Gibraltar, the Bay of Biscay, and the English Channel, would either be transmitted by rail from the East direct to England, or would be carried by steamer to Marseilles only, and thence forwarded by the Paris, Lyons, and Mediterranean Railway to England. The cost of carriage by rail would be heavy, perhaps, as compared with the cost of transmission by steamer; but on the other hand, there would be a great saving of time. The length of voyage from Gibraltar to Plymouth is about 1050 miles, while the distance, as a crow flies, from Marseilles to London, across France, is about 650. From Marseilles to London by water is over 2000 miles, and represents a voyage of eight or nine days. The run by rail across France ought not to occupy more than forty-eight hours. The value of the saving of time would be very great, and in addition all the risks incurred by the transit of the Bay of Biscay and the Channel would be avoided. Under the circumstances it seems more than probable that nearly everything would be transmitted by rail through France, save heavy goods, such as grain, despatch in the transport of which would be of no importance. What the effect of all this would be, on our southern ports especially, may be imagined. Of course this presupposes that the railway charges would not be prohibitive, about which there is no certainty, and that sufficient accommodation would be provided by the railway company, which is also doubtful.

We do not attach so much importance to Captain Aylmer's argument as it may seem to deserve, because it is based on what seems to us to be an unwarrantable assumption. Before our sea-borne trade can be affected, the Channel Tunnel must admit of being worked with ease, rapidity, and certainty. This is the second point referred to above. Now we have absolutely no warrant of any kind for making such an assertion, but we have a great deal of reason for saying that it will, after all, be perhaps easier to make the tunnel than it will be to work it when made. On this subject Sir Edward Watkin is as silent as the grave. Not a single proposition has yet been put into such a shape that it could be fairly criticised. The prevailing notion seems to be, "Let us have the tunnel first, and we can work it afterwards." The Government may have nothing to do with this part of the scheme, but we once more warn intending shareholders not to invest one sixpence in the scheme until a satisfactory answer is given to the question, "How are the trains to be propelled?" To answer this question will be found extremely difficult. Ordinary locomotives, it is quite certain, cannot be used. There remain but three other methods of propulsion—Lamm and Francq's fireless locomotives, compressed air locomotives, and electricity. Is there any reason to conclude that any one of these devices has attained a position which would entitle it to be regarded as supplying a satisfactory means of conducting the traffic between this country and the Continent? Let our readers fancy how the passengers in a train, the engine of which had broken down, would feel knowing that they were ten miles from daylight and 300ft. below the bottom of the sea. There never was a line proposed which it is so imperative should be worked with the utmost certainty and absence of risk, and yet the only means proposed for working it are three, not one of which is able to deal with even a few miles of tramway with certainty and without hitches and delays. We do not say that means cannot be devised for working the traffic of a Channel Tunnel, but we do say that no scheme of the kind which will bear a moment's inspection has yet been brought before the public.

NON-CONDENSING STEAM ENGINES.

To judge from the statements constantly made to us there is a good deal of misapprehension afloat concerning what can be accomplished by makers of non-condensing engines. If we believed all that has been told us from time to time, it is not an unusual thing to get an indicated horse-power with $2\frac{1}{2}$ lb. of coal. We need not say that we do not believe such statements. We have no doubt at all that they are made in perfect good faith. Unfortunately, however, it is not every engineer who can take a diagram, or read one when he has got it; and the number of those who can conduct an experiment to the often bitter end is still smaller. As a matter of fact, the development of one horse-power from 3 lb. of coal burned in the furnace of a Cornish or Lancashire boiler, the engine being non-condensing, is to be regarded as an exceptional feat, reflecting a great deal of credit on all concerned. It is by no means difficult, indeed, to show that this must of necessity be the case. The theoretical efficiency of any heat engine is given by the well-known formula, $E = \frac{T - t}{T}$, where T is the temperature at which the fluid enters the working cylinder, and t is the temperature at which it leaves it. Let us take, for example, the case of an engine using steam with an absolute pressure of 100 lb. The safety valve load would probably be about 90 lb. Now the temperature of steam of this pressure is 328 deg. It will leave the cylinder, or at least cease to do work in it, which is the same thing, when the absolute pressure has fallen, let us say, to 20 lb.; that is to say, the pressure shown by the indicator will be 5 lb. The temperature of 20 lb. steam is 228 deg. Then $E = \frac{328 \text{ deg.} - 228 \text{ deg.}}{328} = \cdot 304$. In other words, of the whole of the available heat contained in the steam, which must not be confounded with the total heat, but 0·3 can be utilised. If the engine were fitted with a condenser the figures would be $\frac{328 \text{ deg.} - 170 \text{ deg.}}{328 \text{ deg.}} = \cdot 481$. Here 170 deg. corresponds to a pressure of 7 lb. absolute, which is about that in the cylinder just before the exhaust port opens. As to the total possible work to be done, we may say that 1 lb. of steam of 100 lb. pressure requires for its production from water at 32 deg. just 1181 units, each unit representing 772 foot-pounds; so that the pound of steam stands for $1181 \times 772 = 911{,}732$ foot-pounds. But it must be remembered that the steam leaves the cylinder as steam, not as water, and carries away a great deal of heat with it. There is this great difference between working with steam and with hot air, that in the first case we have to *make* our working fluid, and in the latter case we find it ready made to our hand. In unmaking the steam, if we may use the word, by condensing it, we can gain a certain advantage. That is to say, a portion of the work expended in evaporating the water will be returned, and this is what is gained by using a condensing engine. The energy expended in making steam is used up in two ways, namely, in overcoming the resistance of the air, and in overcoming the force which retains the water molecules in propinquity. Now this latter force is much greater than that exerted by the air, but no known means exist of getting any portion of the work done in overcoming it back again. That is to say, no work can be got out of the liquefaction of steam, standing alone.

It is not difficult to show that practically the quantity of steam which must be used by a non-condensing engine renders a high economy impossible. When steam is admitted behind a piston, and pushes that piston before it, it of necessity fills all the space, ports, &c., behind the piston. Knowing the pressure of the steam and the space which one pound of it can fill, we know the work that it can do. Thus, for example, one pound of steam of the stated pressure, 100 lb., will have a volume of 4·33 cubic feet, and a pressure of 14,400 lb. per square foot. We know, therefore, that if admitted below a piston one square foot in area, it would be competent to lift a load of very nearly 14,400 lb. through a height of 4·33ft. The work done without expansion will thus be 62,352 foot-pounds, and if we take Mr. D. K. Clark's allowance, 7 per cent. for clearance, we find that the steam may do work amounting to 58,273 foot-pounds. It must be understood that this is without expansion or cylinder condensation. If we take 58,000 foot-pounds as the work in round numbers, then not less than 34 lb. of such steam will be required per horse-power per hour, and this would be the least quantity that a non-condensing engine working steam full stroke, as some pumping engines do, could use. The maximum amount of expansion possible is fivefold in the non-condensing engine. Were it greater, the terminal pressure would fall below 20 lb. Used with this ratio of expansion, one pound of 100 lb. steam represents 142,000 foot-pounds, and $\frac{1,980,000}{142,000} = 14$ nearly, and 14 lb. of steam is the least possible quantity which a non-condensing engine working under the conditions could get on with. But 142,000 is the total number of foot-pounds of work that can be got out of the steam, and only the net work is useful. By expanding the steam five times, the piston before referred to is enabled to make a stroke of $5 \times 4{\cdot}33 = 21{\cdot}65$ft.; but the pressure of the atmosphere must be overcome, and this represents $144 \times 15 \times 21{\cdot}65 = 46764$ foot-pounds. Deducting this from 142,000, our figures stand $\frac{1,980,000}{95,236} = 20{\cdot}7$ lb. This, be it understood, is absolutely the smallest weight of steam of 100 lb. that it is possible to get a horse-power out of in a non-condensing engine, and this, be it remembered, on the assumption that no loss whatever takes place by cylinder condensation or other cause; nor does it make any allowance for loss by compression or leakage. But it is known that in practice heavy losses are incurred in this way, and we shall be quite under the mark if we allow 7 lb. of steam per horse per hour to cover them; but this brings the consumption up to say, 28 lb. per horse per hour, and it may be taken as certain that the quantity used will not be less than this.

Now the Lancashire and Cornish boiler cannot be trusted to evaporate more than at most 9 lb. of water per pound of coal. This corresponds to an ostensible evaporation of 10 lb. of feed-water. There is hardly a boiler in the market which does not send away in the shape of insensible priming, that is to say, as mist suspended in the steam, about 10 per cent. of the whole of the feed-water pumped into the boiler. It will be seen that if the boiler evaporates 9 lb. per pound of coal, and the engine needs 28 lb. of steam—the water sent into the cylinder does not count—while a pound of coal makes but 9 lb., that more than 3 lb. of coal per horse per hour will be used. We know for a fact that a great deal more than we have stated is actually required. Some years ago we carried out experiments with a very good type of non-condensing horizontal engine, with a separate cut-off on the back of the main slide. This engine had a jacketted cylinder, and required 42 lb. of water per horse per hour. Another engine of much the same kind, without the expansion slide, used 56 lb. Our readers may rest certain that 28 lb. is an extraordinarily low consumption. Now, that under these conditions a horse-power can be had for 2·5 lb. of coal passes comprehension, unless, indeed, the coal evaporates 11·2 lb. of water per pound, a performance which is quite out of the question with a Cornish or Lancashire boiler, representing, as it does, an ostensible evaporation of at least 12 lb. per pound of coal. It is possible with a quick moving engine, properly loaded, excellent valve gear, and a cylinder kept hot—as, for example, in a smoke-box—to get down to 3 lb. of coal; but it is not easy. There is reason to think that locomotives do with less now and then; but the locomotive is an exceptional machine, and its extreme piston speed and the conditions under which the steam is worked in it are more conducive to economy than is the case with the ordinary engine. There are combinations of engine and boiler which are far more economical than the combination of stationary boiler and engine, often separated by a considerable distance from each other. But the smallest consumption of fuel in such combined engines of which we have personal experience, was that of the compound engine by Messrs. Garrett, of which full particulars appeared in our pages on November 26th, 1880, and in this case the engine used about 23 lb. of steam per horse per hour. In this case the ratio of expansion was somewhat greater than fivefold, and the loss by condensation in the cylinder was less than 7 lb.

THE RAMISSERAM SHIP CANAL.

ACCUSTOMED as we now are to read almost daily of new schemes for shortening sea communication by cuts to be made through intervening tongues of land, we become inclined to overlook those which were broached in days gone by. The proposal to render available for ships of a large class the narrow passage which has from time immemorial always existed at Paumben—between Ceylon and India—is of very old date. For the last forty years the Indian Government has been steadily improving this passage, until, from its original condition, in which it was only just able to pass small native craft of very light draft, it is now available for all ships drawing up to twelve feet of water. The proposal to supersede this channel by one of a more ambitious character has been before the public for certainly twenty-five or thirty years, but it has long been deemed to involve expenditure which could not possibly be repaid by tolls to be collected on the amount of shipping which would probably make use of it.

Within the last six months, however, a fresh movement has been made in this matter. A mercantile firm in Colombo recently sent a representative to interview the Governor of Madras on the subject, and he pointed out to his Excellency, with what was, doubtless, his strong personal conviction, the benefits which might be expected to result from shortening the passage between Colombo and Madras, as, indeed, for all ships bound to and from the ports of the Bay of Bengal from and for the southward. The Madras Government thereupon instructed the Master Attendant of Madras to proceed to the site of the projected canal and furnish a special report upon its eligibility for the formation of a deep water channel. The result is that the report furnished is condemnatory of such a project being carried out at the point suggested, it demonstrating that, although there exist no insuperable difficulties to the absolute work of forming such a channel, yet that it would have to be extended for so great a distance on either side to reach soundings which would admit of its approach by large vessels, that the scheme became, under such conditions, absolutely impracticable. The report showed that for more than a mile to the north and south of the contemplated entrances there scarcely exists more than twelve feet of water, and such a depth would be wholly insufficient for the class of shipping by which our Indian trade is now carried. The report concludes with a suggestion that there being more favourable approaches available nearer to and absolutely within Madras territory, any proposal to be considered should, by preference, be fixed within the near jurisdiction of the government of that Presidency.

There are many residents in Ceylon who, desirous as they were at one time of seeing such a scheme as that under reference carried out, have materially altered their views since their own immediate interests became more largely absorbed in the prosperity of their own port of Colombo, where, as from time to time noticed in our columns, protective works of an extensive character have long been in progress and now nearly approach completion. A not unnatural conclusion is forced upon these now opponents of a deep-water canal through Ramisseram that if the approach to Madras is to be shortened from the southward by two days, it may considerably lessen the quantity of the shipping which will resort to their own port *en route* for coaling and other purposes; that such vessels would, in fact, give Colombo the go-by when passing up the Gulf of Manaar northwards. A glance at the map will show our readers the peculiar formation of the neck of land which practically joins Ceylon with the mainland of India, of which there can be no doubt that in very remote periods the coffee island formed part. The major portion of the course of any canal through the island of Ramisseram would have to be cut through sand, or, at the worst, through very soft coral, and its promoters allege this as a strong argument to prove the economical possibility of the work. But they certainly appear, to judge from the Master Attendant's report, to have looked only to this part of the question, and to have wholly ignored the difficulties which a practical seaman at once discovered. It would be one thing, it is evident, to make the canal; it would be another for a ship to be enabled to enter it.

After all, it has not, we consider, been satisfactorily demonstrated that, were this canal made, captains of large steamers would like to use it. There is nothing that a seaman desires more than plenty of sea-room, and it can scarcely be said that the Gulf of Manaar affords this. That indefatigable bank-former, the coral worm, is always at work within its narrow waters, and banks formed by it are found at long distances from the shore upon which no warning beacon can be placed to guide the masters of large ships drawing from 15ft. to 20ft. of water. That gulf also is noted, as are so many engulfed or narrow waters, for a particularly nasty sea and strong and diverse currents, all tending to drive a ship from her true course. So far for the southern approach to the proposed site of the canal, but, presuming that to be passed, the dangers and difficulties of navigation for ships of large tonnage would be even materially increased. Palk's Straits, as that portion of sea which lies between Northern Ceylon and the adjacent Indian coast is termed, are, we should say, about as undesirable a piece of water as any captain of a large ship could wish not to find himself in. The coral worm has found here even a more congenial home for its operations than it has to the southward of Ramisseram. Small scattered islets, fringed by widely-extended coral reefs, abound, while out in what is apparently mid-ocean the same insidious worker has created shoals so numerous and so dangerous, that it is no uncommon sight when sailing along in deep water to see almost alongside your craft native fishermen employed with their nets standing in water which scarcely reaches to their waists. For many miles of this navigation even masters of small steamers, of years of experience in these particular waters, never leave their bridge, and keep the lead constantly going. We scarcely fancy the captains of strange and much larger craft would feel comfortable under such circumstances. Would, therefore, the canal, if made, offer inducements of a shortened route sufficient to compensate for such disadvantages? We doubt it extremely, and believe that the plan so long talked of, were it carried out, would never prove to be a commercial success, or afford any advantage apart from that consideration which would justify the required outlay.

THE BUILDING TRADES EXHIBITION.

THE growing popularity and commercial success of special trade exhibitions or periodical markets is well illustrated by the large number of exhibitors and the large display at the Building Trades Exhibition now open at the Agricultural Hall. This is the fourth of these annual exhibitions. The first was very poorly supported by the building trades. Each year the support has been better, and this year the whole of the ground floor of the Hall is well filled, almost wholly by strictly legitimate exhibits. To confine the Exhibition to articles relevant to the building trades may be looked upon as an easy task, because it is so difficult to say where the list of those things which are required for building or for buildings begins and where it ceases. It was nevertheless, with even so large a field, difficult at first to get manufacturers and others to support this Exhibition sufficiently to fill the Hall with legitimate objects. That has, however, apparently passed, and as an Exhibition it seems to be quite successful. Whether it is so to exhibitors we cannot say; but we notice that some who exhibited last year are absent this, though many others appear in their place. From an engineering point of view there is little in the Hall to call for any special mention on our part. The display of machinery is much larger than before, and is worthy the attention of builders and wood-workers generally. Of sanitary appliances there is a very large show, and it will certainly be through public indifference if public ignorance of the nature and use of the various necessaries of this class remains as a check to the spread of a healthy interest in the things and the measures which tend to satisfactory hygienic conditions. There is an almost innumerable number of exhibits of ventilators, fireplaces, ranges and stoves, concrete building details, such as window frames, mullion windows, balustrades, copings, cornices, &c.; closets, lavatory fittings, gulleys, traps, taps, cowls, systems of glazing, waterproof paper roofing, and so on, which we can only mention. There is also a large display of wood parquetry, which is much superior to that of last year, and the same must be said of the various wall decorations in lincrusta, plain and embossed papers, and what are known as leather papers of the Japanese character. In all these and other decorative work there is a marked improvement on last year's Exhibition, and there is some furniture of the really good class and workmanship. All these things show off exceedingly in comparison with some of the vulgar designs and poor workmanship which are also to be found in the Exhibition, presumably, though not necessarily, at lower prices. Some of the nicest decorative work is certainly not the dearest. There is also a very considerable display of building materials and joinery, paint, cement, and ironwork, the display of builders' small ironwork fittings showing improvements in design and attention to finish. One of the most noticeable displays of decorative design and workmanship is that made by the *Journal of Decorative Art*, the specimens exhibited being the results of the second annual prize competition scheme, in which the journal gave away a considerable sum in prizes. The exhibits are full sized specimens of wall, dado, door, and other decorative design and finished painted work, the whole forming a collection worth special notice. It may be remarked that the catalogue of the Exhibition is well arrranged, has complete indexes and side columns for visitors' notes.

THE ACHILLES IN HYDE PARK.

THE bronze, or rather gun-metal figure of Achilles which the ladies of England set up in Hyde Park to commemorate the achievements of Wellington and his army, when the present century was in its teens, is suffering, like many of us, from the effects of the weather, and has fallen—as Mr. Shaw-Lefevre acknowledged last week in the House of Commons—into a sad state of corrosion. It is not, it is true, so dilapidated as some of our public monuments—as that of Queen Anne, in St. Paul's Churchyard, for example. The metal, however, is entirely broken through, and just below the right knee has separated perhaps an inch and a-half, and leaves a grievously wide crack, in which any London boy would long to lodge a stone. The right leg is also in a bad way, being cracked across above the knee. The shield he holds above his head lets daylight through, and his thighs, where the decay is, after all, more material, because the change is confined to the corrosion of the metal, are in such a way that he might say with the St. Simeon Stylites of Tennyson :—

And both my thighs are rotted with the dew.

Professional advice will be called in; and, so it is hinted by some of our contemporaries, that among other remedies, a coat of paint will be suggested; but Mr. Shaw-Lefevre, or any one else who makes the heartless proposal, should first see how they could brave the insinuation of the English climate in a "coat of paint." Why, they say, not let out Achilles as an advertisement for some fashionable ulster, with a label, "This style, two guineas?" But this is aimless joking. The damage is of two kinds—the actual cracks and the corrosion of the metal. The metal can doubtless be brought together again and soldered; the other is due to the formation of a patina. Not, alas! the fine green patina found on old Greek bronzes and coins, which appears sometimes to closely approximate in composition with malachite and sometimes with atacamite, or an oxychloride, but what appears to be a sulphide—it is too dark of colour for the proper patina. Perhaps, the formation of an artificial patina might be encouraged, only it must not be done with strong agents, or the effect will be that of a "modern French antique," as seen on certain lamps, than which nothing could be more horrible. The patina is formed artificially by wetting the surface of the metal with dilute solution of acetic acid, nitrate of copper, sal-ammoniac—chloride of ammonium—and salt of sorrel, &c., and exposing it to the air. That the deposit may have the requisite hardness. It must be formed slowly, and hence it is necessary to use dilute solution. Some experiments were conducted some fifteen years since in Berlin, when it was found that a treatment once a month of the surface of bronze with olive oil, combined with frequent washing of the surface with water, aided in developing an artificial patina. The climate of London will never allow of the formation of a really fine patina, it will always be of too dark a hue.

PROTECTION AGAINST COLLISIONS AT SEA.

THE German newspapers have of late given much attention to various proposals for diminishing the destructive force of collisions at sea. The *Cologne Gazette* has recently summarised various proposals which have been made, and remarks that in both freight and passenger steamers the engine-room is not sufficiently protected by the coal receivers on each side against injury and against the access of water. Particular stress is laid on the necessity of the bulkhead being strengthened in the first instance in such a manner as to obviate the necessity of any stanchioning being executed in the event of a collision, as this precautionary measure—resorted to with the idea of obtaining additional protection against the expected pressure of water—should not be necessary if the work has been made sufficiently strong in the first instance, while the labour thus occupied after a collision can be ill-spared from the other work of the vessel at such a moment. The attention of marine surveyors is called to the advisability of the strength of the bulkhead being regarded quite as much as that of the outer skin. If, however, the use of extra supports is necessary, it is suggested that they should be kept ready for immediate use, or should be placed in position during the loading of the ship. It is further suggested that in all cases the bulkheads should reach to the upper deck, and not to the main deck only; also, that any unavoidable openings in them should be so arranged as to close automatically, or to be thoroughly closed from the upper deck at any time. It is, however, remarked that the fact of bulkheads being used at all is a confession on the part of shipbuilders that the forces to which vessels are exposed in collisions are, in many instances, of an irresistible nature. Hence, it is argued that a practical remedy for these disastrous occurrences is only to be found in an increase in the strength of those parts of a ship which are exposed to the shock in collisions. It is remarked that in the case of the Cimbria, and in similar instances, it was only the decks which prevented the Sultan from penetrating further than it did through the ill-fated Cimbria. Thus it is recommended that the attention of marine constructors should be devoted to the strengthening of the decks throughout the whole length of the outward portion of the ship with massive or compound plates about 3ft. wide, so bolted and secured in their position as to offer the greatest degree of resistance to the shock of a collision. It is further remarked that if a knee or part-bulkhead of massive iron plates be so arranged as to protect the outer edge of the deck against being bent upwards or downwards, the opposition against the penetration of a colliding vessel is of an effective nature. This arrangement does not, it is said, interfere with the general plan of a ship, and by making the chances of injury about equal between two colliding vessels, tends to ensure greater care in navigation.

THE BRITISH ASSOCIATION AND CANADA.

THE Committee of the British Association for the Advancement of Science has issued a circular addressed to the members, asking them to state their intention concerning the proposed visit to Montreal next year; and along with it is a letter from Sir A. T. Galt, High Commissioner for Canada, in which he says:—"Committees on Invitation, on Finance, and on Conveyance have already been formed, and a guarantee fund opened very satisfactorily, while the Government of the Dominion, in view of the wide-spread interest which the matter has awakened, will ask Parliament during its present session to vote a considerable sum—20,000 dols.—as a contribution to the funds that will be subscribed by the public." For the purpose of giving to the members a probable idea of the expenses they may be called upon to defray during their stay in Canada, he proceeds:—"Dr. Sterry Hunt desires me to say that the committee will arrange fifty free passages for the conveyance of the officers of the Association whose attendance is indispensable at its annual meetings. The funds at the disposal of the committee will also enable it to negotiate with the steamship companies for the reduction of the ordinary ocean passages in favour of *bonâ fide* members of the Association. Two courses are open in which this can be done: to arrange for a number of the passages to be offered at the single rate for the double journey, say £15 10s., or for a general reduction so far as funds will permit. I am to state that the committee is prepared, with the aid of a Government grant, to devote £3000 to these purposes alone. In reply to Prof. Bonney's question as to the expenses of board and lodging for the members of the British Association during the meeting in Montreal, the committee will give assurance that free entertainment will be provided for at least 150, and probably for all other members who may attend. I may amplify this by stating for your information that the tariff of the Montreal hotels ranges from 2 dols. 50 cents, to 4 dols. per day inclusive, and that private accommodation can be obtained much lower than in England." Dr. Sterry Hunt also says: "As to the proposed excursions we are prepared to say that the Grand Trunk, the Canada Pacific, and the Intercolonial Railways will furnish free transportation over their lines throughout the Dominion of Canada, from Nova Scotia to the North-West. The Canada Pacific will also arrange an excursion to the Rocky Mountains, and the Grand Trunk one to the Great Lakes—which includes Niagara—and Chicago, while the South-Eastern Railway will do the same for the White Mountains, and Portland, and Boston. In an excursion of this kind, occupying three or four weeks, tourists should be provided with, say, £20 in money for hotels, carriages, and other incidental expenses, though it is possible that a less sum than this would be needed."

CHEMICAL VENTILATION OF THE UNDERGROUND RAILWAY.

SOME experiments were made last week at the Mission Hall, Church-street, Lisson-grove, Edgware-road, with regard to a chemical mode of ventilation suggested as being applicable to underground railways. The apparatus employed consisted of pieces of woollen material forming an open network, and suspended from the top of the room, the lower end resting in a solution of caustic soda. When in operation these punkahs, as they are called, are swayed backwards and forwards and the solution drawn up by the woollen tissue rapidly absorbs the carbonic acid, or sulphuretted hydrogen in the air and leaves it pure and comparatively cool. Before the test began the air of the room was made tolerably bad by the gas burners and the presence of some fifty persons, all the ordinary ventilation openings being purposely stopped; and in addition to this sulphur was burned in the apartment until the point of semi-suffocation was reached. The punkahs were then set in motion, and in ten minutes all trace of sulphur had disappeared, and the thermometer showed a fall of 7 deg. in temperature, the only sensible evidence of the process employed being that the air was not unlike that of a room recently whitewashed. Dr. Neale, the inventor of this arrangement, suggested that it could be adopted on the Underground Railway, and if attached to each train would, as an auxiliary to the existing ventilation, so purify the tunnels of smoke, heat, dust, carbonic acid, and sulphurous acid gases, as to render additional shafts unnecessary. He computed that the cost would not exceed 1s. per train journey, and that this would be compensated by first-class passengers who now avoid the underground lines on account of the state of the atmosphere. For hospitals and excessively crowded rooms it appeared to offer great advantages. With regard to the immediate object of the demonstrator, the practicability of the "chemical lung," as it is called, being made an efficient purifier of the tunnels of the Metropolitan and District Railways, nothing but an experimental trial on a considerable scale could, of course, determine. The question is whether there is no other mode of reducing this evil than destroying public gardens and marring public thoroughfares, and whether, if the company has to take what does not belong to it, it ought not to pay. We may say that one means of meeting the difficulty to some extent would be to provide the end of the last train at night with a stock of milk of lime which should be squirted on to the upper part of the inside of the tunnel.

GREASE IN BOILERS.

M. BOUR, engineer to the Lyons Boiler Association, lately read a paper before the *Société des Sciences Industrielles* of that city on "Some Difficulty Encountered with the Boiler of the Steamer Allobroge plying on the Lake of Annecy," and which he attributed to the presence of grease in the boiler. The boiler, with internal flue, rivetted at the front end, and return tubes, was carefully made of MM. Debiaune et Cie., of Lyons, and certified for a pressure of 6 kilogrammes per square centimetre, or 85 lb. per square inch. It was started in May, 1882, and after working well for a few days showed signs of leakage. The tubes were tightened up, and the number of stays connecting the ends diminished to lessen the rigidity; but, after four or five voyages the leaks began again. After more elasticity was given without satisfactory result, it was decided to renew the boiler. As the same difficulty was still encountered, M. Bour was requested to inspect the new boiler. No defect was discovered, but a quantity of light, whitish, greasy mud was taken out. On treating this substance with hydrochloric acid, a large proportion of grease was found. M. Bour advised that the boiler should be filled, and a few kilogrammes (1 *k.* = 2·2 lb.) of soda crystals and quick lime added, so as to produce caustic soda; that it should be washed out, and refilled, and that on starting again it should be fed directly from the lake. The boiler went on well until an attempt was made to again take the feed from the condenser. It was then decided to draw entirely from the lake, and thenceforth no difficulty was experienced. The company has another steamer navigating the lake, the boiler of which is fed from the condenser without causing any difficulty; but in this case the pump draws from the lower portion, thus keeping clear of the grease. Now, the old boiler of the Allobroge fed in the same manner as the new, never caused any difficulty. It would, therefore, appear that grease exercises an injurious influence only under certain circumstances, which are not yet explained. M. Bour has found that when the steam draws along with it a certain quantity of water, the calcareous salts contained in the water form with the grease of the cylinders and steam chests a solid soap, the hard pieces of which cause a breakage in the cylinder covers. This is not the case, however, where mineral oil is used, which, therefore, appears to be a remedy.

SLIDING SCALES IN MINERAL TRADES.

THE question of sliding scales in the mineral industries is being pushed to the front very much just now—the Northumberland miners having adopted one, while the ironworkers of Durham have one in contemplation. In the latter case, however, there is the objectionable accompaniment of a proposed restriction of the production with the intention of forcing up wages. On the general question of restriction we have already said enough in these columns, but it is worth while stating the effect that it would have on any sliding scale arrangement. Such an arrangement is chiefly valuable because it adapts itself from time to time to the changes in the state of trade, as defined by the prices for which the product of labour is sold, and it varies as needed the rate of pay for labour to the fluctuations in the volume and value of trade, and therefore to the market value of labour. Possibly the movements of the scale may be slower than those of the labour market; indeed, they usually follow slowly in its track, but still they do reflect the movement, and therein is their chief value. But to add to the scale a movement that would interfere with such reflection is to defeat the object for which the scale in reality exists. If by any artificial means the price of the iron is forced up locally, and that price is allowed to define the rate of wages, it is evident that it will be out of proportion to the rate in other districts where there is no such artificial movement, and where labour is paid according to the value. This is the main objection, though there are others of some moment, not the least of which is the fact that the adoption of restriction, coupled with a sliding scale, places the employers who adopt it at a disadvantage in connection with their competitors who are free. That disadvantage is serious, because it is shown by increased wages to pay, and by a lessened production in a given time from a certain amount of plant. Nor does the higher price compensate them, because there is with it not only the two disadvantages we have spoken of, but there is the further one that under present conditions of trade in the North the rate of cost of raw materials frequently rises with augmentations in the price of the product. Under all the circumstances, then, a sliding scale should be free and unfettered, and in that case it may be fairly expected to reflect, if slowly, the condition of trade and the value of the labour.

THE NEW SLIDING SCALE IN THE IRON TRADE.

THE settlement that has been come to in the manufactured iron trade of the North of England is one that is a new departure in some respects in the iron trade of the North, but in others it is a return to early methods. It introduces the novelty of a sliding scale with a restrictive action accompaniment, and it also introduces the novelty of ascertainments of prices every two months instead of three as at the present time. But the basis of the scale is an old one—1s. in the £ on the price of the iron being the rate of pay of the puddlers with the addition of 1s. 6d.; and, differing from the last scale, the average realised price is that of the whole of the iron sold by the associated makers, instead of the plates, angles, and bars only. As the restriction is to become inoperative if all the iron manufacturers of the North do not join in the scheme and continue it, it is likely to be less enduring than has been supposed; but its failure, if it occurs, is not to affect that of the working of the scale, nor of any of the other conditions. Hence it may be supposed that the rate of wages in the manufactured iron trade of the North is now settled for some time, and that there will be some reduction of the production of plates which may affect the price in the market. It remains to be seen whether that effect will stimulate the production of plates in other centres of the iron trade, or whether it will cause a substitution of steel plates for iron for shipbuilding purposes. The experiment that has been decided upon in the iron trade of the North of England is one that will be watched with the keenest interest beyond even the circle of those interested in the iron trade, because it is an attempt to reconcile the sliding scale principle—the determination of the rate of wages by the price of the product of the labour paid for—with the principle of restriction, the first aim of which is the forcing up of the price by the lessening of the labour. How far these two principles are antagonistic has been conjectured, but hitherto it has not been tested. That test is now to be applied, and the application will be watched with great interest.

BASIC FURNACE LININGS.

KUTSCHA, OELWEIN AND MERTENS recommend for furnace linings the use of the mineral agalmatolite, occurring at Dilln, near Schemnitz, in Hungary. Its composition is:—Silicic acid, 30·40; alumina, 52·68; iron oxide, 0·80; manganese oxide, 0·30; lime, 0·89; magnesia, 0·39; sulphuric acid, 0·80; water, 11·88; alkalies, 1·50; total, 99·64. By mixing two parts of burnt agalmatolite with one of the raw mineral and moistening the mass with water, the mixture may be pressed into briquettes which on burning at a white heat become hard and adhesive, and do not shrink. For the preparation of basic linings it is proposed to add to lime or dolomite a flux in such proportion that the mixture after twelve hours' burning at a white heat forms a slag which is pulverised and worked up with suitable binding agents. For the manufacture of such basic refractory masses, dolomite of the following composition is used:—Silicic acid, 0·7; alumina, 0·5; iron oxide, 0·6; lime, 31·5; magnesia, 20·0; carbonic acid, 46·7; mixed with 12 per cent. of talc of the composition:—Silicic acid, 62·0; magnesia, 31·0; iron oxide, 2·0; water, 5·0. The mixture is formed into bricks, heated for twelve hours at a white heat, pulverised, treated with from 5 to 8 per cent. of tar, from 3 to 5 per cent. of pitch, or from 5 to 10 per cent. of resin, pressed whilst hot in heated moulds and burnt at a high temperature. Bollinger recommends the use of a mixture of asbestos, chrysolite, and magnesium chloride for the preparation of refractory basic linings.

SOUTH KENSINGTON MUSEUM.—EASTER WEEK.—Visitors during the week ending March 31st, 1883:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 32,268; mercantile marine, Indian section, and other collections, 22,120. On Wednesday, Thursday, and Friday, free, from 10 a.m. to 6 p.m., Museum, 5872; mercantile marine, Indian section, and other collections, 4523. Total, 64,783. Average of corresponding week in former years, 49,612. Total from the opening of the Museum, 21,869,374.

LITERATURE.

Our Iron Roads: Their History, Construction, and Administration. By FREDERICK S. WILLIAMS. Second Edition Revised. London: Bemrose and Sons. 1883.

THIS is a much enlarged edition of a work originally published in 1852, and is one which will no doubt find a very large circle of readers, for it treats in a popular way of the history, construction, and administration of railways of England, America, and the Continent. The author does not aim at making railway constructors or administrators, but gives in popular language the history of early railway enterprise, inventions, and the struggles of inventors, promoters, and those who did most to establish railway enterprise; and, with descriptions of those railways, and sections of railways which afford striking examples of great works accomplished, he gives the social and personal side of that branch of industry which has done as much or more to civilise the world than any other work of man. The book is thus of much interest to engineers, for it supplies that information which writers in journals such as our own and of engineering books usually exclude as not utilitarian, but which engineers are nevertheless glad to talk over and hear in conversation. By the great travelling public the book will be found to convey in familiar terms sufficient knowledge of the construction and working of railways, and of the purposes of the visible machinery and apparatus of railways, to make them interesting; while the fund of anecdote and narrative which the author so frequently draws upon maintains interest in the book as in a story. Nothing seems more remarkable than the incessant warfare into which the early projectors and constructors of railways were thrown by those who placed every obstacle in the way of the new enterprise, often to the great loss of their posterity, as, for instance, in the case of the people of Colchester and some other towns, who made the railway companies construct their lines so as to pass some distance from, instead of running into, the town.

Of historic narrative almost all pertains to the English railways, though the author gives some interesting particulars relating to American railways, and more especially that of the Pennsylvania Company, which runs through some of the most remarkable scenery in the world, portions of which are illustrated in this book by illustrations which seem to be taken from Mr. W. B. Sipes' interesting account of the Pennsylvania Railroad.* Amongst other continental railways referred to are the St. Gothard, while the most recent example of railway work is the armour-clad train employed in Egypt. Mr. Williams gives a good account of the work and difficulties of engineers, surveyors, managers, and others, and not a little of the interest of the book is excited by the narratives of navvy life and characteristics, as well as by otherwise unrecorded history and incident in which railway kings, well-known and little-known engineers, and others were concerned.

ROADS IN SWITZERLAND.

No. I.

THE time is not distant when many of our readers will find their way to Switzerland. The roads in that country have long been found to possess much that is interesting to the engineer, but very little has been published concerning them in a definite form. About three years ago M. G. Bavier, an engineer and Member of the Swiss National Council, wrote a book on the subject of considerable merit. The work is published by Messrs. Orell, Füssli et Cie., Zurich, and to it we are indebted for most of the information contained in the following article.

In treating on this subject M. Bavier has spared no pains in obtaining material to make what he has to say concerning it complete, and the care with which he has sifted evidence, rejecting all that is doubtful and inconsistent with parallel history, has given a stamp of accuracy and truth to the record which will render it a most valuable book of reference, devoid of the tautology and inculcation of elementary principles, which, as a rule, form the leading features in continental compilations of this kind, besides containing a fund of information as interesting as it is varied, which will make it quite as acceptable to foreign as to native engineers. He has divided his statements into chronological periods, thereby adding an historical value to the classification, and has extended the range of his facts from the earliest ages down to the most recent reports, distinguishing the various epochs of advance or stagnation by individual treatment of the works or neglect for which each is conspicuous.

The construction of roads in Switzerland is doubtless contemporary with the inroad of the Romans, although there is presumptive evidence of the pre-existence of footpaths over some of the Passes which were afterwards adopted as bases for commercial improvement by the conquerors. As early as 58 B.C., and in the following year, Cæsar conquered the Helvetians with a view to obtaining a free passage over the Alps, and a generation later the Emperor Augustus, with the same object, invaded the country again for the purpose of rectifying the northern and eastern frontiers from the mouth of the Rhine to the Bodensee, and thence in a direct line to the Danube. The oldest known roads supposed to have been trodden some centuries B.C. were the frequented paths which led from the great St. Bernhard, the Alpine passes from Milan and Como, over Chiavenna, the Julier, Septimer, and Splügen, over Mandrisis, Lugano and Bellinzona, and the Bernhardin, above Chur, into the valley of the Rhine, along its banks to Bregenz and the Bodensee, and thence over Kempton to Augsburg.

The first real improvements were commenced under Cæsar over the great St. Bernhard, in compliance with the increased demands of traffic, and were completed in the reign of Augustus. Later on the Simplon road was under-

* Published in this country by Messrs. Sampson, Low, and Co.

taken; but there are no data to prove that the Gothard pass was ever used in the time of the Romans. With regard to these early roads, M. Bavier says:—"The Roman Alpine roads in Switzerland were of two kinds, mountain paths and made roads; the former, as a rule, dating from a very early period—most probably from centuries B.C.—were only bridle paths following the contour of the Alps without any protection, and at the time of Augustus—as mentioned by Strabo—were very dangerous; the only two which he denominates as practicable being the Salassier Pass—Mont Cenis—and the Okra Pass in the Illyrian Alps. The latter were military roads, divided into stations supplied with mile posts, and of a width of from 2 to 3½ metres. These were well paved throughout on the bed, the latter being slightly arched and composed of large stones, with dressed retaining walls and an upper stratum of clayey soil, well mixed and stamped with gravel. The accompanying cross sections, Figs. 1 to 5, show their present state. In many parts the bed was formed of béton, over which paving stones 9in. thick—*statumen*—were laid; then 9in. of bedded stones in mortar —*rudus*—covered with 3in. of béton—*nucleus*—and the top or *summa crusta* composed of fine gravel. This costly mode of construction was, however, confined to the plains, and then only in inhabited districts."

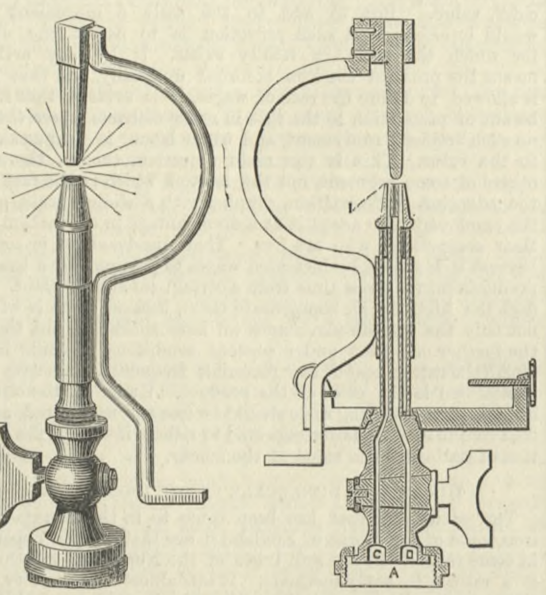
The roads in the mountains, following generally the sunny slopes, were seldom cut deep into the sides of the precipices, but rather carried out on them, whereby large bridges over watercourses were avoided. No traces of large viaducts have been found, and judging from the form of construction adopted, more care seems to have been expended in reducing the contingencies of repairs and maintenance than in producing costly works of art as monuments of their skill in design and execution. More attention seems to have been paid to the roads over the Septimer and Bernhardine than to that over the Splügen Pass, as the arrangements for drainage and cleaning are well and solidly constructed. The remains of stone columns are still to be found, as shown in Figs. 5 and 6, evidently used to make the roads in winter, or occasionally to serve as milestones.

M. Bavier gives a map copied by Peutinger, showing the different Roman military roads, and supposed by some to have been compiled under Septimus Severus, Antonius Pius, and Alexander Severus — 193-235 — but dated by Peutinger 393, under Theodosius Magnus. The military map of the whole of the Roman Empire, completed about 1265 by a monk at Colmar, is in the Imperial Library at Vienna. Without entering into details of route, the list of the Roman Alpine roads may be summed up as follows:—(1) From Milan to Mayence, over the Great St. Bernhard, with a branch to Vevey and Besançon. (2) From Geneva to Lago Maggiore, over the Simplon. (3) From Chur to Bellinzona, over the Lukmaier. (4) Also from Chur to Bellinzona, over the Bernhardine, used by Constantine in 396 for the passage of his army. (5) From Chiavenna over the Splügen; this road was only 1½ metres wide. (6) The old military road over the Septimer, traces of which can be found over the whole mountain; this road was 2·7 metres wide. (7) The road over the Julier, the date of which is somewhat doubtful. Many columns—as shown in Fig. 5 and 6—as well as retaining walls and a bridge—shown in Figs. 9 to 11—tend to favour the belief that whatever may have been the origin of this road its improvements are entirely due to Roman enterprise. There were besides these ten main and six branch roads in the valleys of Switzerland at the time of the Romans, bearing marks and relics which testify to the assiduity with which these pioneers of civilisation prosecuted their efforts. The germ implanted by them, however, failed for nearly fifteen hundred years to ripen into maturity, for, from the fall of the Roman Empire to the commencement of the eighteenth century few, if any, improvements were made, the monumental works of the conquerors were neglected and given over to ruin by the vanquished, and although vast armies have from time to time forced their way through the mountain passes from the days of Hannibal and Cæsar to those of Napoleon and Suwarrow, in later times at least, the successful inroads have spoken more for the strength and endurance of the men than for the condition and durability of the roads. Many of the latter again degenerated into the bridle paths from which they were originally made, and the art of construction, which appeared to die with the withdrawal of foreign interference, was not really revived until the commencement of the present century. A temporary impulse was given to construction by the pilgrimages to certain shrines, to the Holy Land, and by the Crusades, and during the twelfth century Switzerland was drawn into the mercantile world from her natural position—offering a central mart for the interchange of goods between the north and south. One remarkable feature about the Roman roads in Switzerland is the engineering skill exhibited in the choice of route, in many cases identical with the trace of the existing railways, showing with what care the shortest and most practical directions were studied at so early a period. M. Bavier has devoted some space to a detailed description of the scanty improvements during the abovenamed period, interspersed with statutes enacted from time to time for their maintenance and tolls, which are principally interesting as specimens of the quaint orthography of the early Germans, and of the laudable simplicity and curtness of ancient documents, as compared with the complicated and verbose municipal decrees of the present day. Evidence is also given of the first use of gunpowder in the construction of roads on the Albula Pass in 1696, where a gallery had to be cut through a precipitous rock, confirmed by Herrn Franz Rziha, engineer, of Vienna, who says, "The historical note which ascribes the invention of powder to the monk Berthold Schwarz, in 1330, is not tenable; according to Dr. Fleischer's researches, and from the works of Markus Græcus—*liber ignium ad comburendos hostes*—it is satisfactorily proved that powder was invented in the beginning of the previous century. Blasting by gunpowder was discovered by Martin Weigel, a Saxon mining engineer, in 1613, but the improvements on the Bergüner Steiner—Albula Pass—in 1696 must be admitted to be its first application in the construction of roads. Figs. 12 and 14 show cross sections of the style of road built in 1750, still existing near Aargauerstalden. The gas lamp is evidently a modern addition, but the profile is the same as at first.

A NEW LIGHT.

The annexed engraving shows a new light, the invention of Captain A. De Khotinsky, of St. Petersburg, as described by Leon Warnerke. It is a simple form of the Drummond light, viz., it is produced by heating to incandescence a refractory prism of a peculiar construction.

In the Drummond light combustion is produced by oxygen and ordinary coal gas, but in the new light the novelty consists in the following: The refractory material has the shape of a prism or pencil made of a specially prepared magnesia compound, which is unaffected by air, and is even not spoiled by water; it stands the temperature so well that, although it looks so delicate and thin, it will remain burning for 300 hours. A stream of oxygen and coal gas under very low pressure—5in. of water—is directed on to the axis of the prism, which becomes incandescent, and, unlike the Drummond light, it is not a point, but a line of light of about 2in. long, and, moreover, this light radiates all round. When coal gas is not to be obtained it can be superseded by paraffin, spirit, or other form of lamp. In St. Petersburg it is in use at the State Paper Manufactory, where colour printing is executed on a very large scale. In the shops where coloured silks and other fabrics are sold the advantage of the new white light is especially appreciated. The size and shape of the burners and prisms are made in great variety, so as to give light from 25 to 300 candles.



There are also some special lamps constructed for use under water by divers, also for mines, and for places where no combustible gas can be used, and for powder magazines. These lamps are hermetically closed glass vessels, having a spirit or paraffin lamp and a small tube connected with the reservoir of oxygen. The products of combustion partly accumulate in the shape of water in a specially reserved space, and gases escape through capillary openings which permit the passage of the gases but not of the water.

A manufactory of oxygen is, however, the foundation stone of this new system of illumination. According to the inventor he has succeeded in perfecting the system of production of oxygen to such an extent that it will be possible, if only one small manufactory is established in London, to produce oxygen at the rate of 20,000 cubic feet daily, at a cost of 7s. per 1000 cubic feet—this includes the cost of materials, 10 per cent. on capital, wages, taxes, repair of ovens and machines. The cost of refractory prisms is 4s. per 100. This is the comparative cost of the new light per hour, based on the previous data:—25-candle burner will consume oxygen, 1755 cubic inches cost 0·070d.; 25-candle burner will consume ordinary gas, 1 cubic foot, 0·038d.; total, 0·108d. The same amount of light obtained with 12½ cubic feet of ordinary gas will cost 0·475d. By comparing these data, the new light will be cheaper than ordinary gas for the same amount of work. Mr. Warnerke read his paper before the Photographic Society, and expressed the hope that we may soon have the benefit of this new light in London, as being much superior to gas or to the incandescent electric light, while it is also more simple and cheaper.

Purifying Air for Breathing.—An apparatus—Stanley's patent—is now being brought out for the purposes of cooling, purifying, and disinfecting the air of saloons, cabins, hospitals, &c., by Mr. W. L. Thompson, of York-buildings, Adelphi. The system consists in pumping cold water through pipes which are fixed in the ceilings, running the length and across the saloon or ward in an hospital. In these pipes are fixed rods, outside which it is intended that a thin film of water shall trickle down, which will be regulated by a cap fitted to the upper end of the rod. The water, in thus running down the rod, will, it is claimed, absorb all the particles of dust, &c., that may be floating in the air, also cool and purify the vitiated atmosphere; and any of the known purifying chemical agents can be mixed with the water for the purpose of disinfecting, such as Condy's fluid. The water, after running down the rods, will be carried away by an arrangement of pipes under the flooring. To prevent any contact with the water, a guard of brass wire gauze can be fixed.

Telegraphs of the Ancients.—On the 14th ult. Mr. W. H. Bailey, Salford, delivered a lecture on "Telegraphs of the Ancients, from the Fall of Troy to the Battle of Waterloo," at the Peel Park Museum, Salford. He first dealt with the conversation by signs as carried on by savage tribes of America and Africa, and to telegraph signs as employed in warfare and defence before the Christian era. More particularly he described the alphabetical double clepsydra telegraph employed by the ancient Greeks, and pointed out the similarity between this and the double clock telegraph introduced by Sir Francis Ronalds about 1815. Agamemnon's telegraph, in which a torch or beacon light announced the fall of Troy, and the torch telegraph of the Scotch were next described, but the lecturer could give little information as to any systems adcpted in old England, though he made some reference to the apparently general use of beacons at fixed stations. The flash light system of telegraphy, invented by the Rev. James Brenner at the beginning of this century, and the signals used during the American War of Independence next occupied his attention. Early marine telegraphs, Nelson's signal, pendants, semaphore signals, and their origin, were next dwelt upon, the lecturer concluding with an interesting account of the Ronalds electric telegraph.

ON STEAM YACHTS.*

By Mr. Dixon Kemp.

The prejudice which existed against the introduction of steam yachting, was such that in 1829 the members of the Royal Yacht Squadron—at that date almost the sole arbiters in yachting affairs—decided that no gentleman owning a vessel propelled by steam power could be a member of the club. This rule was levelled against Mr. Thomas Assheton Smith, of Tedworth, an ardent yachtsman, who had already built five large yachts for competitive sailing. However, Mr. Smith was so fascinated with the achievements of steam that in 1828 he resigned his membership of the Royal Yacht Squadron, in order to indulge in his desire to possess a steam yacht. He commissioned Mr. Robert Napier, of Glasgow, to build this yacht, which was supplemented at subsequent dates by the following:—

Date.	Yachts.	Tons.	N.H.P.
1829	Menai	400	120
1837	Glowworm	300	100
1838	Fire King	700	230
1843	No. 1 Fire Queen	110	30
1844	No. 2 Fire Queen	230	80
1845	No. 3 Fire Queen	300	120
1849	Jenny Lind	220	70
1851	Sea Serpent	250	80

All these yachts, except the No. 2 Fire Queen, were propelled by paddle wheels, and No. 3 Fire Queen is still in existence, being the Port Admiral's Yacht at Portsmouth. No. 2 Fire Queen was a screw, and the lines and drawings of her engines are given in Bourne's "Treatise on the Screw Propeller," 1852 edition. No other steam yachts of any considerable size were built until about the year 1856, when, the Royal Yacht Squadron having removed their edict against steam, Mr. Talbot Clifton—their vice-commodore—converted his topsail schooner Capricorn into a steam yacht. In the following year there were four other steam yachts —ranging from 30 to 240 tons—in existence. In 1864 there were as many as thirty steam yachts afloat, and from that date they multiplied very fast, until in the year 1877 there existed 280 of five tons and upwards. Since the numbers have nearly doubled, and the present fleet of British steam yachts is now made up as follows:—

	Number of Yachts.	Tonnage.
5 and under 100 tons	300	8,550
100 ,, 200 ,,	48	6,170
200 ,, 300 ,,	25	6,270
300 ,, 400 ,,	23	7,700
400 tons and upwards	25	12,732
Total	421	41,422

From the foregoing it will be gathered that steam yachting now occupies a very important place in naval architecture, and it is a significant fact that no large sailing yacht of or above 200 tons has been built during the last six years. The cause of this can be easily understood if we realise that a large number of men take to yachting for some reason other than a love of the art of sailing or of managing a yacht under canvas; in fact, they know nothing of the art, nor seek to learn anything about it. To these, yachting means shifting about from port to port with unerring certainty, and in agreeable weather. This really forms the charm of steam yachting to those who simply enjoy being on the sea for the sake of being there, or take to it to recruit shattered health, as they can shift ports or do a day's cruising in the most pleasant of all weather on the sea—a calm—when the sailing yacht would be lying helpless. This leads us to consider whether auxiliary steam power would not be sufficient for the purposes of yachting, so that a man might, as occasions permitted, enjoy all the pleasures and fascinations of sailing, and at the same time be able when necessary to make passages in calm weather or against baffling winds. This was the early idea of steam yachting, although its originator, Mr. Assheton Smith, had no such divided notion about it; but the first large steam yachts, Capricorn, Erminia, and Firefly, which existed before 1860, had nothing but auxiliary power, and could steam no more than about six knots an hour. At that time, however, the great objection to a full power steamer was that the consumption of coal was very large, and the boiler and engines occupied more space than could well be spared. At the present time the relative advantages of the full-power steamer and the auxiliary can be summed up as follows: In the auxiliary, the engine and boiler space in a fore-and-aft direction is within a foot or two as great as in a full-power steamer. The first cost is greater, owing to the greater depth of hull and expense of the equipment of masts, rigging, and sails; and the cost of working is very considerably greater, as a full crew of sailors must be carried, besides the engineers and stokers; and the loss of weight due to the consumption of coal may seriously affect the performance of the auxiliary under canvas, and moreover, if the coal is not used from about the centre of buoyancy, there will be the difficulty of trim to contend with, which, although it may be of little consequence to the full-power steamer, might be a serious matter for the auxiliary if she had to work against a foul wind. On the other hand, the auxiliary for extended ocean voyages, such as the Sunbeam, Wanderer, Lancashire Witch, and Marchesa have made, has many advantages. She may reel off three or four thousand miles upon a stretch under sail,† and thus effect a great saving in coal and frequently make greater speed, should the wind be strong, than could be made under steam. Beyond this, the auxiliary steam-yacht has greater weight—due to her greater under water depth—in order that she may carry a considerable weight of ballast, and this has the effect of making her a much better sea boat than a full-powered steamer would be of similar length, but of less breadth and depth. The advantages to be gained by making use of the trade winds in ocean voyages are clear enough, but for home cruising, or even for cruising in the Mediterranean, the full-power steamer is the more economical, as she will have to do nine miles out of ten under steam, and to carry about a large crew and heavy outfit of sails which are never required would mean an entirely unnecessary expense. As might be supposed, steam yachts afford great opportunities for naval architects to achieve a comparatively high rate of speed for any given displacement and engine power; but they are not entirely unfettered in this respect, as the sea-going qualities of the yacht must always be considered, and this is a matter which very materially influences form. As a rule, a steam yacht has much about the same relative fineness in the fore-body that a sailing yacht has; but owing to her lesser proportionate breadth for any given length the water lines in the fore-body make a less angle, and the same feature is observable in the after-body. The form of midship section, however, varies very considerably from that of the sailing yacht, which usually has a high bilge; whilst the steam yacht, having to provide capacity for carrying a large weight of coal—usually about 20 per cent. of her total weight—engines, and ballast, carries her side much lower down before it begins to turn in to form the bilge—a feature which has a tendency to promote easiness in a seaway. Allusion has been made to the introduction of steam in yachting so far back as 1828, and at that date it will be remembered the form of hull supposed to be the best adapted for speed was known as the cod's head and mackerel's tail form; in other words, the entrance was made considerably fuller than the run, and the centre of buoyancy was invariably forward of the mid length. However, Mr. Assheton Smith, in designing his steam yachts, made an entirely new departure, as he designed the entrance at least as fine

* Read at the twenty-fourth session of the Intitution of Naval Architects, 15th March, 1883.

† The Lancashire Witch did the distance—4458 miles—from the Falkland Islands to Natal in 23 days, the biggest run being 295 miles entirely under canvas; and she did the distance from Yokohama—4400—also in 23 days, her biggest run being again 295 miles in 24 hours; and she did the whole distance from Tahiti to Liverpool—11,030 miles—in 79 days, having covered, owing to head winds, 12,240 miles. The Sunbeam, in her voyage round the world, also did many good runs under canvas, having on one occasion logged 299 miles. The Sunbeam's best day's steaming was 230 miles, and Lancashire Witch's 216.

as the run, and his No. 2 Fire Queen had an even finer fore and after body than is to be found in any steam yacht of similar size of the present day.* The year following the construction of the Fire Queen in 1844, the royal yacht Fairy was constructed for the use of her Majesty, and her lines resemble those of the Fire Queen in a remarkable manner, but the Fairy is the fuller of the two in the ends.

	Fairy.	No. 2 Fire Queen.
Length on L.W.L.	140·0ft.†	127ft.†
Beam, extreme	21·1ft.	19·6ft.
Draught of water	5ft.	6ft.
Area of midship section	74·5 sq. ft.	76·2 sq. ft.
Displacement	176·5 tons.	143·5 tons.
Speed on trial	13·3 knots.	12·2 knots.
I.H.P.	364	250
Speed co-efficient $\frac{Speed^3 \times D^{2/3}}{I.H.P.}$	198	196

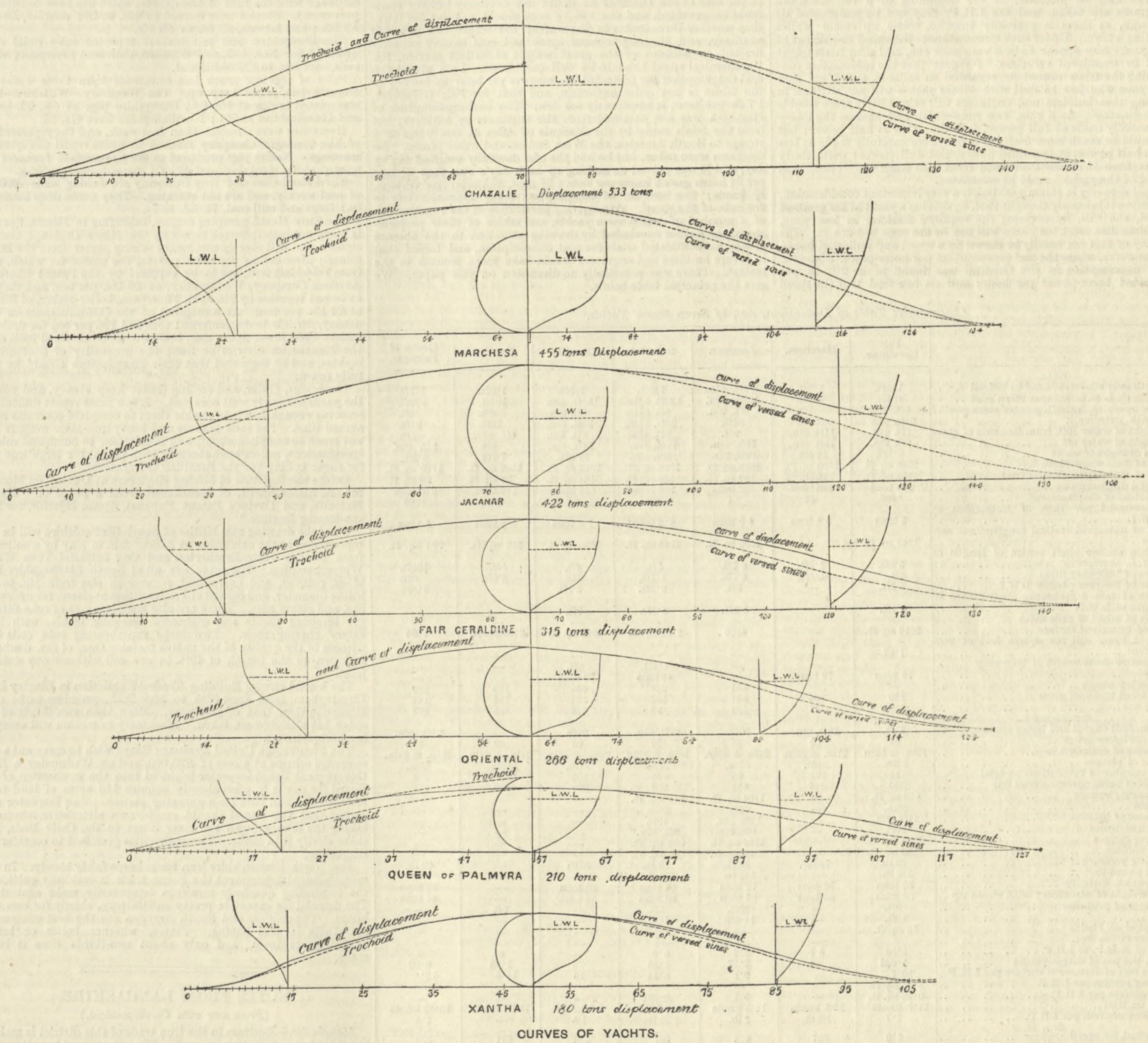
† The screw aperture not included.

Each of these two yachts had the midship section placed three or four feet ahead of the mid-length—not including screw aperture—and both were designed with a view of obtaining the very highest speed, and, judged by the displacement speed co-efficient, they certainly compare favourably with yachts of the present day; and, so far as their individual merits go, they appear to have been about equal. There is, however, no doubt that the co-efficient would have been higher had the two boats been driven by engines of the modern type indicating equal horse-power, as in the contrivances then used to give increased rotation to the screw much useful power must have been lost. As a means of comparing the forms of various yachts of the present day, a curve of sectional areas has been constructed of seven well-known yachts. All the curves are in the same proportion, the sections in each case having been divided by 10, and the quotient was made to represent an ordinate at the station of each section. To compare the relative fulness or fineness of the fore-body, a curve of versed sines in each case is given as a standard, 5 per cent. being added to the fore-length for the fine end of the curve of versed sines. In all cases this curve would be too fine for the after-body, and, as a means of comparison here, a trochoidal curve is used, with a radius in each case equal to one-tenth the length of the after-body. It might here be said that the curve of displacement of the Fire Queen exactly coincides with a curve of versed sines both in fore-body and after-body. In the case of these yachts, those whose curves most nearly approach the standard curve are Xantha, Oriental, and Marchesa. So far as the fore-body is concerned, the greatest departure from the curve is to be found in the Jacamar; yet she, judged by her speed co-efficient, is a remarkably easy vessel to drive. With regard to the after-body, the greatest departure from the standard curve is to be met with in the Queen of Palmyra. This vessel has a small midship section and full ends; indeed, she has a remarkable fulness aft; and this latter fulness was a necessary condition in her design, as her engines and coal bunkers are very far aft—much farther, in fact, than is usual when the driving power is carried aft. The Oriental's curve for the fore-body, it will be seen, nearly coincides with the curve of versed sines, and her after-body makes an exact trochoid; the Fair Geraldine, on the other hand, shows a considerable departure in both ends, being much fuller than the standard curves. According to the particulars of the trial trips given me by the builders, the Fair Geraldine's as nearly as possible equalled that of the Oriental; and I do not think any mistake was made about her speed or I.H.P.,† as her builders, Messrs. Ramage and Ferguson, have recently written to me to confirm the particulars of the trial. The trial of the Oriental was, I believe, conducted by Mr. John Inglis, jun., her designer and builder, and, as the trial was a progressive one, there is every reason for supposing that no mistake was made. The Xantha is a vessel designed by Mr. John Harvey, and engined by Palmer and Co. She not only has a wave curve of displacement, but has also strongly pronounced wave lines in her bow. Her speed, however, compared with that of Fair Geraldine, is nothing remarkable. The Chazalie was built by Messrs. Camper and Nicholson, and the Queen of Palmyra by Messrs. Payne, both being engined by Messrs. Day, Summers and Co. They were very carefully tried on the mile on different occasions, and it will be seen that their speed co-efficients are nearly equal, and are very low compared with the other yachts. It may perhaps be useful to examine these displacement curves and the alleged performances of the different yachts a little more closely. Upon reference to the tables it will be seen that the Fair Geraldine is nearly 16ft. longer than the Oriental, and on her trial was 8 tons lighter, whilst the engines of each indicated 330-H.P. It might reasonably have been supposed that the greater length of Fair Geraldine,* the displacement remaining the same, would have admitted of her being driven considerably faster than the Oriental with any given horse-power, but, as a fact, her speed was only equal; and there can be no doubt that the comparatively better performance of the Oriental is due to her finer ends, which, in turn, are due to her greater area of midship section.

The Fair Geraldine, it will be observed, compared with the Oriental, had on her trial a small midship section, and, to obtain the desired displacement, the ends had necessarily to be fuller. Judged by the midship section co-efficient, the Oriental's performance on her trial was a much better one than Fair Geraldine's; and this feature is what might have been expected, judging by the results obtained by the late Mr. Froude, in experimenting with an increasing area of midship section, the displacement remaining constant. In the case, however, of Oriental, the midship section is not only of greater area than Fair Geraldine's, but the hull is shorter; and whether any of the good results obtained are due to the longitudinal disposition of her displacement—which disposition would be dependent upon the form of her lines—I am at present unable to say; but in connection with this subject I may mention that I have for some time past been making arrangements for the Marquis of Exeter, for testing models of most of the steam yachts, particulars of which are given in the table which follows, together with various other models, in order to test the value of certain forms of lines and dispositions of displacement in their relation to speed. I hope to conclude the experiments during this year, and shall be glad if I am allowed to communicate the results to this Institution.

The Marchesa was designed and built by Messrs. Lobnitz and Co., and her speed co-efficient with 245 indicated horse-power appears to be a very remarkable one; as, even allowing for the low speed of 10·5 knots she was driven at, the co-efficient 283 is something very unusual. Were it not for the equally remarkable speed co-efficient of Jacamar, one would be apt to attribute Marchesa's achievement to the circumstance that her displacement is distributed in a fore-and-aft direction, nearly in accordance with the wave form; but in the face of what Jacamar is alleged to have accomplished, there is nothing to justify one stating that there is any value in such distribution. However, with the knowledge of the uncertainty of arriving at the exact or efficient horse-power used on a trial trip, it would be the merest speculation to ascribe the various results obtained on the trials of some of the seven steamers named to any particular cause.

Fortunately, in the case of the Oriental, the trial was conducted with unusual care and completeness; and her speed curve is very instructive in throwing doubt on the alleged results of some of the trials of the other yachts. From this curve we learn that at speeds between two and five knots the resistance increases in a less ratio than the square of the speed, and after passing five knots it exceeds that ratio, until at eight knots it equals the cube of the speed.



CURVES OF YACHTS.

* In 1857 there was a controversy as to whether Mr. Assheton Smith or Mr. J. Scott Russell was entitled to the honour of having discovered the value of hollow lines or waved lines, and Mr. Robert Napier was requested to state what he knew of the matter. This he did in a letter as follows:—"I am certain that hollow lines were a favourite plan of Mr. Smith long before he ever built a steam yacht; for when contracting for the Menai steam yacht—in 1829—he told me that he had put a new bow with hollow lines on to his sailing yacht Menai, which had increased her speed greatly, and he wished the same kind of bow put into the steamer, but Mr. Wood, the shipbuilder, being opposed to hollow lines, he gave in; but when Mr. Smith decided to build the Fire King he resolved that the lines should be hollow, according to his own plan. Everyone condemned the plan, and continued of that opinion till the day of her trial on the Gareloch, when her unexpectedly great success changed not only the opinions but the practice of all connected with steamers. From that day a rapid change took place in the form of all steamers requiring speed, by giving them hollow instead of round lines. From all that I know of these hollow lines, the theory of them may belong to this or that person, but that the practical introduction and adaptation of hollow water lines to steamers entirely belong to Mr. Smith." Sir Roderick Murchison also stated in a letter that Mr. Smith informed him in 1844 that he was led to consider the wave form when he was a boy at Eton, it having been pointed out in the course of a lecture that a flat stone when sinking in water described a gentle curve; and assuming it took the line of least resistance, he inferred that the entrance of a ship in the water should be in the form of a similar curve. Sir Roderick then went on to say:—"Whilst, however, there can be no doubt that Mr. Thomas Assheton Smith marked out this result—*i.e.*, the application of hollow lines to the entrance of ships—entirely by his own ingenuity, it is now admitted by men of science that Mr. Scott Russell is the person who, by analysing the nature, forms, and movements of waves, arrived, by philosophical induction, at the correct application of the wave principle to shipbuilding." It is not contended that Mr. Scott Russell discovered his "wave of translation" until 1834, when he began some resistance experiments, and in the following year he built the Wave, which had a wave line bow. However, so far back as 1830, Mr. Wood, of Port Glasgow, who built the Menai, constructed a boat for the Paisley and Ardrossan Canal with hollow lines, and he seems to have been so little satisfied with the result that he persuaded Mr. Smith to abandon the idea in the Menai. Several other canal boats were also built in Glasgow with hollow lines about 1835. *Vide* "Reminiscences of Thomas Assheton Smith:" J. Murray, London, 1860.

† The speed of Fair Geraldine was verified at Nice regatta, but her I.H.P. was not indicated.

* The displacement of Fair Geraldine on her trial was 258 tons, but with her bunkers full it is 315 tons, and draught of water aft 10ft. 6in., forward 8ft. 3in.

From here the ratio increases very rapidly, and at nine knots equals the fourth power of the speed. This ratio is steadily maintained to 11·4 knots, the maximum speed at which the yacht was driven. To have obtained a speed of 12·5 knots at least 480-horse power would have been required, or the same as it is alleged drove Jacamar 12·5 knots, that yacht having 60 per cent. greater displacement. It is possible, of course, that the resistance in the case of the Oriental would not increase as the fourth power of the speed up to 12·5 knots; but so far as my experience goes, I see no reason to expect a diminution in the ratio of the growth of the resistance.

The speed which Marchesa is alleged to have obtained with 245-horse power is 10·5 knots. Now this is exactly the speed the Oriental obtained with 245-horse power, and it seems incredible that Marchesa, which has 75 per cent. greater displacement, could have equalled Oriental's performance. The speed—8·9 knots—given by Messrs Day, Summers, and Co., for Chazalie, is a reasonable one; but I cannot help concluding that some mistake must have been made in the trials in the case of the Marchesa and Jacamar. As the builders of these two vessels also built the engines, they had no reason, of course, to make the horse-power appear higher than it really was, so long as the guaranteed speed was obtained; and it is just possible that sufficient care was not taken in calculating the diagrams, or in counting the revolutions. In the case where the engines are not built by the firm which constructs the yacht, it is possible that more than the stipulated I.H.P. may be indicated at the beginning of a run when the diagrams are taken, and the I.H.P. may not be maintained all through, as there is generally time to bottle up steam whilst making a turn. Under such circumstances the speed co-efficient of the yacht may appear to be a very poor one, and such trials might well be considered valueless. I regret that the information concerning the trials cannot be regarded as reliable, and I am sure everyone who has to deal with steam yachts will join with me in hoping that builders and engineers will take a little more trouble in the matter. As a rule, two runs—with and against the tide—are usually made at full power, and the same at half power; but it would be much more useful if a run were carefully made at less than half power, at two-third power, and full power; particularly so, as from the results obtained from such trials the "economical speed of the yacht" could be calculated.

Coal economy in steam yachting is a very important consideration, and often it is hastily thought that, by driving a yacht at her greatest speed, she will, by covering the required distance in less time, consume less coal, as there will not be the time to burn it. The fallacy of this can readily be shown by a speed and indicated horse-power curve, where the coal consumption per horse-power is known. This consumption in the Oriental was found to be 2·12 lb. per indicated horse-power per hour; and on her trial trip the speed made with 52 indicated horse-power was 6·95 knots; with 90 indicated horse-power, 8·4 knots; and with 330 indicated horse-power, 11·4 knots. The coal capacity of the Oriental is thirty-three tons; and assume that she had to steam 3500 miles, with no possibility of coaling on the passage, if she started at full speed, and maintained it by keeping up 330-I.H.P., she would exhaust her coal in 105 hours—4 days 9 hours—or when she had only steamed 1200 miles; but if she started at eight knots, on 82-I.H.P., she would be able to steam the whole distance, 3500 miles, with the thirty-three tons of coal; but the time consumed would be 438 hours—18 days 6 hours—instead of 307—12 days 19 hours—if she could have maintained full speed the whole distance; but to have kept up the speed of 11·4 knots for the shorter time she would require 45·2 tons of coal. The saving of twelve tons of coal, as against thirteen instead of eighteen days' steaming, would not perhaps be considered a sufficient set-off under ordinary circumstances; but frequently a steam yacht, when making long passages, may be so placed that it would be of the most vital importance that she should be run at the most economical speed. A few years ago, a case occurred in the voyage of the Eothen from America to England, when she ran short of coals; and, from ignorance of what the yacht would consume if run at a low speed of about six knots, she was driven at the top of her speed—which, however, did not exceed eight knots—with the result that she could not fetch her port, but had to put into a coaling station. In considering this matter it would also be right to note the effect of putting twelve tons extra coal on board. In the case of the Oriental no doubt the necessary bunker space could be provided, and the twelve tons would not put her lower than another three inches in the water; but where the power is auxiliary, and the engine-room space and coal bunker capacity limited on account of the great weight of ballast carried, the "economical speed" should be well considered. I am afraid the coal consumption per indicated horse-power per hour as set out in the tables is not quite authentic, and that for Fair Geraldine, 1·7 lb. per hour, is apparently too low. The coal consumption of Marchesa was not obtained from the engineers or builders; but from the trials made by the Marquis of Ailsa at sea, when on a voyage to South America, the West Indies, and other places. No diagrams were taken, but he had the coal carefully weighed day by day, and it was proved on making up each day's run that 2¼ tons per 24 hours gave 8 knots per hour; 2¾ tons, 8¾ knots; and 3¼ tons, 9¼ knots; the increase of consumption being approximately as the cube of the speed. After giving particulars of the construction of a number of well-known yachts, and tables of their performances, the author concluded by drawing attention to the absence of well authenticated trials for coal consumption, and hoped that in future builders and engineers would take more trouble in the matter. There was practically no discussion on this paper. We give the principal table below.

Comparative Table of Dimensions, &c., of Seven Steam Yachts.

	Fair Geraldine.	Marchesa.	Jacamar.	Oriental.	Chazalie.	Xantha.	Queen of Palmyra.
HULL.							
Length over all—stem head to taffrail	153ft.	150ft.	172ft. 6in.	143ft.	169ft.	116ft.	143ft.
Length on L.W.L. to inner stern post	136ft.	127ft.	155ft. 6in.	120ft. 3½in.	150ft. 6in.	101ft.	124ft.
Screw aperture, including outer stern post	4ft. 9in.	7ft.	4ft. 9in.	4ft. 0½in.	6ft. 9in.	4ft.	4ft.
Breadth, extreme	21ft. 2in.	25ft.	24ft.	20ft. 1¼in.	28ft. 6in.	19ft.	21ft.
Draught of water 10ft. from fore side of stem	7ft. 6in.	11ft. 7in.	9ft.	7ft. 4in.	9ft. 6in.	6ft. 8in.	7ft.
Draught of water aft	9ft. 9in.	13ft. 4in.	11ft. 6in.	10ft. 2in.	14ft. 4in.	9ft.	9ft. 6in.
Mean draught of water	9·1ft.	12·5ft.	10ft. 2in.	8ft. 8in.	12·3ft.	7·7ft.	8·2ft.
Area of load water-plane	2080 sq. ft.	2360 sq. ft.	2655 sq. ft.	1726 sq. ft.	2908 sq. ft.	1520 sq. ft.	1780 sq. ft.
Area of midship section on trial	105 sq. ft.	176 sq. ft.	168 sq. ft.	126 sq. ft.	184 sq. ft.	98 sq. ft.	95 sq. ft.
On trial displacement	258 tons	465 tons	422 tons	266 tons	533 tons	180 tons	210 tons
Coefficient of displacement	·403	·42	·4	·46	·37	·41	·393
Displacement per inch of immersion at L.W.L.	5 tons	5·8 tons	6·3 tons	4·2 tons	7·6 tons	3·6 tons	4 tons
Area of immersed vertical longitudinal section	1240 sq. ft.	—	1590 sq. ft.	1040 sq. ft.	1856 sq. ft.	810 sq. ft.	994 sq. ft.
Midship section abaft centre of length of L.W.L. as above	5·8ft.	2·5ft.	6·7ft.	7ft.	4ft.	5ft.	105ft.
Centre of buoyancy ditto	4ft.	1·5ft.	0·7ft.	1·7ft.	1ft.	2·5ft.	6ft.
Centre of buoyancy below L.W.L.	3·1ft.	—	3ft.	3·2ft.	3·7ft.	—	2·6ft.
Centre of lateral resistance abaft centre of length of L.W.L.	3·1ft.	—	5·5ft.	4·3ft.	7ft.	—	—
Centre of effort of sails ditto	—	—	—	—	—	—	—
Area of immersed surface	3212 sq. ft.	—	4500	2755 sq. ft.	4880 sq. ft.	2190 sq. ft.	2800
Area of lower sail per square foot of wet surface	1·07	—	—	—	—	—	—
Metacentre above centre of buoyancy	—	—	—	4·7ft.	8ft.	—	—
Ballast	30 tons	70 tons	—	40 tons	79 tons	—	—
Builder's tonnage	—	—	451	240	604	182	280
Registered tonnage, gross	189	266	301	167	328	132	142
Ditto, net	128	177	193	80	223	85	103
ENGINE-ROOM.							
Fore-and-aft engine and boiler space	31ft.	28ft. 6in.	39ft.	27ft. 6in.	26ft.	—	28ft. 6in.
Nominal horse-power	54	60	80	50	60	40	45
Diameter of cylinders	18in. & 36in.	21in. & 36in.	23in. & 42in.	18in. & 32in.	20in. & 40in.	24in. & 24in.	16in. & 24in.
Stroke of pistons	22in.	24in.	30in.	24in.	24in.	18in.	24in.
Mean number of revolutions on trial	111	102	95	146	100	—	113
Indicated horse-power on trial trip	330	245	494	330	300	240	272
Condensing surface	630 sq. ft.	—	1104 sq. ft.	512 sq. ft.	—	—	—
Vacuum	26in.	—	26in.	28in.	—	—	—
Diameter of boiler	11ft. 3in.	—	12ft. 9in.	10ft.	—	—	—
Length of boiler	10ft.	—	9ft. 9in.	8ft. 6in.	—	—	—
Heating surface	1041 sq. ft.	—	1126 sq. ft.	696 sq. ft.	—	—	—
Grate surface	66 sq. ft.	—	49 sq. ft.	30 sq. ft.	—	—	—
Working pressure	70 lb.	70 lb.	80 lb.	80 lb.	60 lb.	—	60 lb.
Boiler tested to	140 lb.	—	160 lb.	160 lb.	—	—	—
Coal-bunker capacity	50 tons	70 tons	70 tons	38 tons	80 tons	—	30 tons
Total weight of machinery with steam up	55 tons	68 tons	86 tons	50 tons	58 tons	—	48 tons
Diameter of propeller	9ft.	—	10ft.	7ft.	—	9ft.	—
Pitch	11ft.	—	14·8ft.	10ft.	—	—	—
Surface of all blades	16 sq. ft.	—	—	13½ft.	—	—	—
Number of blades	3	—	—	—	—	—	—
Ratio of N.H.P. to I.H.P.	5·55	4·1	6·2	6·6	—	6	6
I.H.P. per ton of displacement	1·024	·53	1·17	1·25	·56	1·33	0·93
Square feet of immersed surface per I.H.P.	10·7	—	9·1	8·34	16	11·6	12·
Heating surface per I.H.P.	3·47 sq. ft.	—	—	—	—	—	—
Grate surface per I.H.P.	0·22 sq. ft.	—	0·1	0·091	—	—	—
Speed on trial	11·7 knots	10·5 knots	12·5 knots	11·4 knots	8·9 knots	11·75 knots	10·52 knots
Coal consumption per I.H.P.	1·7	1·8 lb.	2 lb.	2·13 lb.	1·8	—	1·8
Coefficient for speed $\frac{S^3 \times M}{I.H.P.}$	510	827	672	567	432	661	524
Ditto $\frac{S^3 \times D^{\frac{2}{3}}}{I.H.P.}$	186	283	221	185	155	216	150
Ditto $\frac{I.H.P.}{M}$	3·14	1·44	2·94	2·6	1·62	2·45	2·37
Ditto $\frac{I.H.P.}{D^{\frac{2}{3}}}$	8·2	4	8·1	8·	4·5	7·5	6·3
SPARS.							
Fore mast, deck to hounds	40ft.	56ft. 6in.	48ft.	36ft. 6in.	57ft. 6in.	—	—
Main mast, deck to hounds	42ft.	61ft.	50ft.	38ft. 6in.	63ft.	—	—
Mizen mast, deck to hounds	37ft.	—	—	—	68ft.	—	—
Fore topmast, pin to sheave	21ft. (c)	34ft. 6in.	30ft. (d)	15ft. 9in.	38ft. 6in.	—	—
Main topmast, pin to sheave hole	23ft.	40ft.	30ft.	16ft.	41ft.	—	—
Mizen topmast ditto	21ft.	—	—	—	43ft. 6in.	—	—
Bowsprit outside stem	20ft.	13ft.	24ft.	15ft.	23ft. 6in.	—	—
Jib boom to shoulder	—	21ft.	—	—	24ft.	—	—
Fore boom	36ft. (d)	36ft. 6in.	—	29ft.	35ft. 6in.	—	—
Main boom	35ft.	64ft.	32ft. (d)	32ft.	36ft. 6in.	—	—
Mizen boom	38ft. 6in.	—	44ft.	—	65ft.	—	—
Fore gaff	20ft.	27ft.	—	—	28ft. 6in.	—	—
Main gaff	17ft.	29ft.	24ft.	18ft. 6in.	29ft.	—	—
Mizen gaff	20ft.	—	25ft.	19ft. 6in.	37ft.	—	—
Squaresail yard	39ft.	—	48ft.	—	65ft.	—	—
Square topsail yard	20ft.	—	—	—	33ft.	—	—
Fore mast, on deck, from a perpendicular to fore side of stem at L.W.L.	28ft.	40ft.	32ft.	26ft. 6in.	32ft.	—	—
Main mast from fore mast, centre to centre	42ft.	39ft.	69ft.	56ft. 6in.	38ft.	—	—
Mizen mast from main mast	40ft.		—	—	39ft.	—	—

IRON TRADE WAGES IN THE UNITED STATES.—The Chattanooga *Times* states that the Scale Committee of the Amalgamated Union have decided on the following scale. It is a reduction of from 15 to 30 per cent. on the wages paid last year:—Price per ton: First heating, 40c.; first helping, 20c.; re-heating, 20c.; first helping, 8½c.; second helping, 5c.; roughing down, 6 5-10c.; roughing up, 5 3-16c.; catching, 5c.; cold straightening, 9c. and 11c.; first hooker, 4½c.; second hooker, 4½c.; third hooker, 1½c.; fourth hooker, 4½c.; sticker in, 3½c.; total, 1·32 dols. 3-10c. This settlement is to stand until June 1st, subject to changes either by the managers or the association. It is also understood that the puddlers are to receive 5 dols. per ton.

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

(*From our own Correspondent.*)

A STRONG market for pig iron, but an easy market for finished iron, continues. There is much necessity that this ease should terminate and manufacturers should attempt more united action in resisting the "bears." The refusals which are now going on to accept some merchants' terms for shipping orders should be multiplied.

In view of the quarterly meetings in Wolverhampton next Wednesday, and in Birmingham next Thursday, business is this week restricted. Good orders for nail strips and tubes were, however, reported to-day to have been booked for Canada; £6 5s. to £6 7s. 6d. was the minimum for strips; hoops are selling fairly at £6 10s. to £6 12s. 6d. Round Oak bars were £8 2s. 6d., ordinary quality, and "lion" bars and those of similar quality £7 10s. per ton; unmarked bars were £6 10s. to £6. For horseshoe bars £6 15s. to £6 12s. 6d. was asked. Common angles ranged from £6 10s. to £7, and T-iron from £7 10s. to £8. Hinge strip was £7 10s. easy.

Boiler-plates keep dull, but girder qualities show a little more activity. The former were quoted to-day at £9 to £9 10s. per ton, and the latter at £8 10s. per ton upwards.

Sheetmakers again complained of the lack of specifications, although with the turn of the quarter there has been a slight improvement. Singles were quoted £7 15s. to £8; doubles, £8 5s. to £8 10s.; and lattens, £9 5s. to £9 10s.

The Shropshire wire rod makers reported sales quiet at £7 upwards for Nos. 4, 5, and 6 rolled, delivered Liverpool; drawn rods were 30s. to £2, additional.

Sales of pigs are much less numerous than three weeks ago. Nevertheless, prices keep up. The Westbury—Wiltshire—brand was quoted to-day at 48s. 6d., Derbyshire pigs at 48s. 9d. to 50s., and Lincolnshires at 50s.; Northamptons were 47s. 6d.

Hematites were stronger than last week, and the representative of the Tredegar Company refused to quote until the quarterly meetings. Native pigs produced at the Capponfield furnaces were quoted at 55s. for mine, and 42s. 6d. for common qualities.

The Pelsall Coal and Iron Company are raising some 6000 tons of coal weekly, and are not stacking. They quote deep house coal 9s.; forge and mill coal, 7s. 6d. to 7s.

The Stow Heath pumping engine, belonging to Messrs. Sparrow, is being put into thorough repair by the Mines Drainage Commissioners, and will shortly commence raising water from the Bilston mines. New boilers are to be put in, the plates for which, made from cold-blast iron, are to be supplied by the Patent Shaft and Axletree Company, Wednesbury, at £9 15s. per ton, and they are to be put together by Mr. John Thompson, boiler-maker, of Bilston, at £4 15s. per ton. At a meeting of the Commissioners on Wednesday, Mr. Cochrane remarked that £14 10s. per ton for first-class boilers was a lower figure than boilers could be obtained from either the Manchester district or from the generality of Staffordshire makers, and he suggested that their manufacture should be carefully noted.

The bridge, girder, and roofing trades keep steady, and most of the yards are fairly well occupied. A few firms report difficulty in securing enough hands to complete contracts in the agreed time. The tank makers and heavy iron-plate workers have not much to complain about, and in addition to home and colonial specifications, orders have recently been placed for large iron pans for sugar boiling for the Brazilian Government.

Before the Institute of Mining Engineers at Dudley, on Monday, Mr. A. Slater Savill, of Manchester, read a paper on "Hamer, Metcalfe, and Davies's Patent Exhaust Steam Injector, for Non-condensing Engines."

The tube drawing capabilities of South Staffordshire will be ably represented at the exhibition at Amsterdam in May by a collection from Messrs. John Brotherton and Co., Imperial Tube Works, Wolverhampton. The tubes are all of South Staffordshire iron, black, painted, and galvanised, ranging in size from ⅛in. to 6in. inside diameter, and consist of twelve different classes for hydraulic, gas, and steam uses. There are also complete sets of tube fittings, gas screwing tackle and engineers' screwing tackle, with brass fitters' chasing tools. Two large superheating tube coils bear witness to the quality of the native metal. One, of ⅝in. diameter is drawn to the length of 49ft. in one coil without any weld or joint.

The second annual Building Trades' Exhibition in Bingley Hall, Birmingham, from April 30th to May 28th, promises to be more attractive than that of last year. More than two-thirds of the space has already been taken. Machinery in motion will occupy a large department.

The Stourbridge United Drainage Board wish to carry out a new sewerage scheme at a cost of £25,000, and on Wednesday a Local Government Board inspector inquired into the application of the Board for power to compulsorily acquire 148 acres of land for a sewage farm and land for a pumping station. The inspector suggested that the Board should consider an alternative scheme of taking the sewage down the river Stour to the Osier Beds, and there clarify it in tanks. The authorities promised to consider the suggestion.

The North Staffordshire iron trade keeps fairly steady. In the manufactured department the home trade is decidedly quiet, and the impending quarterly meetings temporarily make against it. The demand for export is pretty satisfactory, chiefly for bars and hoops. The colonies and South America are the best consumers, and India is also buying. Plates, whether boiler or bridge qualities, are tame, and only about two-thirds time is being made.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Business in the iron trade of this district is making anything but satisfactory progress. The recent spurt has altogether died away, and there is a return of the previous indifference on the part of buyers to give out orders. Beyond a few sales of foundry numbers, there is scarcely anything doing in the pig iron market, and for forge iron there is an almost total absence of inquiry. Prices nominally are being fairly well maintained, as most of the makers, being tolerably well covered by contracts, are under no present necessity to force sales; but so far as the market can be tested, the tone is weaker, and there is a little easing down where orders are at all wanted. In the finished iron trade a conflict is going on between makers and merchants. Manufacturers, who seem to be far more sanguine with regard to the future than is the case generally in the iron trade, are tolerably firm in their prices, but merchants freely offer iron at under the makers' lowest rates.

There was a fairly good attendance at the Manchester iron market on Tuesday, but there was no corresponding amount of business stirring. For pig iron local makers were asking late rates, being 47s. 6d. to 48s., less 2½, for delivery equal to Manchester, and with heavy deliveries against contracts they are not anxious for orders, but it is only for an occasional small parcel that the above figures are obtained. In district brands business is confined to a few small transactions in foundry. Lincolnshire, for which makers in some cases are willing to take a little under full rates, prices averaging about 46s. 4d. to 46s. 10d., less 2½, delivered equal to Manchester; forge is quoted at about 45s. 4d., but upon this figure there is also a tendency to give way in some instances to secure orders.

A rather better inquiry for finished iron was reported in some quarters, but it did not develope any large amount of business. Some of the North Staffordshire houses were asking rather more money, but any business doing was mostly through merchants, at under makers' prices. For delivery into the Manchester district, North Staffordshire bars could be bought at £6 5s. to £6 7s. 6d., and local brands at £6 5s., with sellers in some cases open to take £6 2s. 6d. for odd lines. Shipping inquiries continue small generally, but in hoops a fairly large business has been doing recently for America.

The construction of new mills is still giving moderate employment to the iron trade, and there are several good contracts in the market for mill work both in wrought and cast iron.

The engineering trades do not present any specially new feature. Most of the large firms continue busy, and although the ordinary general engineering branch is only moderately employed, there is a good deal of special work still giving out; the development of electrical appliances is causing a growing demand for special tools, and I understand that fair orders have been given out in connection with the sugar trade, whilst marine engineering still contributes largely to the actual employment of tool makers in this district.

In the coal trade the month has opened with an altogether unexpected reduction of prices in the Manchester district. There has been no very appreciable falling off in the demand up to the present, and there is no actual pressure of supplies in the market, but the heavy stocks held by one large Manchester firm have induced them to reduce their prices, and in this they have been followed by the other leading Manchester colliery concerns. The reduction amounts to 10d. on the delivered rates of house fire coal, and 5d. on furnace coal, engine coal, and slack; house coal is also reduced 10d. per ton at the wharves. Pit prices are, however, not materially altered. This reduction has taken colliery proprietors in other districts by surprise, and as yet they have not decided upon any corresponding action. It is, however, not improbable that with the unsettlement of the market and the advent of warm weather some giving way will be found necessary. At present the average pit prices remain about as under:—Best coals, 9s. 6d. to 10s.; seconds, 7s. 6d. to 8s.; common house fire coals, 6s. 6d. to 7s.; steam and forge coals, 5s. 9d. to 6s. 3d.; burgy, 5s. to 5s. 3d.; good slack, 3s. 9d. to 4s.; with some special sorts fetching 4s. 3d. to 4s. 6d. per ton.

Shipping is very dull, and the business doing during the past week has been very small. Lancashire steam coal, delivered at the high level, Liverpool, or the Garston Docks, can be bought at about 7s. 6d. per ton.

The South-West Lancashire Coalowners' Association are pushing forward their efforts to obtain more adequate facilities for the weighing of coal shipped at Garston at Liverpool, to which I referred a fortnight back. On Friday a deputation waited upon the representatives of the London and North-Western Railway at Garston, when a desire was, I understand, expressed by the company to meet their views if possible, and the matter will be thoroughly gone into at the next meeting of the Association in Manchester.

Barrow.—I cannot report any change in the hematite pig iron trade. Business is quiet, buyers are few; but the material is plentiful. Stocks have accumulated very largely, and should an increased demand set in, some time must necessarily elapse ere prices could go up much, owing to the heavy stocks in the hands of makers and second-hand dealers. The output at the furnaces is fully maintained, and the demand on producers is fairly large, considering the state of the market. Most of these orders, however, come from steel makers, who are very busy, having secured some good contracts. Steel makers are largely sold forward, and this industry is likely to be kept in full employment for some time to come. Prices are unchanged for Bessemer and forge samples. Mixed numbers are quoted at 52s. per ton at the works. Steel makers are adding to their orders, and the mills are in full employment. Prices for steel rails range from £4 17s. 6d. to £5 per ton. The new orders secured by iron shipbuilders will have the effect of improving their position very considerably. Some fair orders have been received. Iron ore is quoted at about 9s. 6d. to 12s. per ton. Not much new business is doing, raisers generally working off existing contracts.

THE SHEFFIELD DISTRICT.

(*From Our Own Correspondent.*)

A PLEASANT change in the weather, though it must cause the house-coal trade to become slack again, is certain to be of great benefit to the country, and therefore, generally, to business. The long frost which has retarded seed operations caused much gloom in the agricultural districts; and now that bright sunshine has succeeded the cold and dark days, there is more animation in the home markets. Travellers in Ireland and Scotland have latterly found it hard to book any orders of consequence, but they are certain to do better during the quarter just opened if the next few weeks continue favourable for harvest operations.

Mr. Thomas Jessop, chairman of William Jessop and Sons, Limited, Brightside Steel Works, is perhaps the leading authority in Sheffield on the steel trade, and he states that from present prospects hopes of a good year may be entertained—so much so that at the annual meeting of his company the other day, he held out hopes of the dividend being increased from 10 to 15 per cent. As a matter of fact, however, the dividend cannot be increased beyond 10 per cent. until the reserve fund has reached an amount which will still require several years' trading.

Iron is again duller, with a downward tendency in prices, and a sympathetic feeling pervades various departments, except in the case of ironfounders who are engaged upon specialities.

Sheffield armour-plates of the Ellis type have now been completed for the Russian cruiser Dmetri Domskoy, building at St. Petersburg, and one of the plates, selected indiscriminately from a number, has been successfully tested in Portsmouth harbour.

Messrs. Watson, Moorwood, and Co., of the Harleston Works, are at present very busily engaged in various iron castings, as well as in the stove-grate department. They have just forwarded to the Builders' Exhibition at South Kensington a remarkably complete combination gas and fire cooking range, which is certain to command a good deal of attention. The arrangements are exceptionally perfect in every respect, and though the range I saw is a large and expensive one, the invention will, no doubt, be brought out in handy sizes for all households.

The Sheffield Gas Company is arranging to hold an exhibition of gas appliances, including baths and boilers heated by gas, boiling stoves, cooking stoves, gas fires, gas cokes, gas apparatus for electro-plating, gas engines, heating stoves, &c. The exhibits will refer specially to articles adapted for domestic and trade purposes. The mayor is to open the exhibition, in connection with which Miss Coles, late staff teacher, National School of Cookery, South Kensington, is to give a course of lectures illustrative of the utility of the appliances for household uses.

The Sheffield Gas Company has just held their annual meeting, and declared the maximum dividend of 10 per cent., while reducing the price of gas by 2d. per 1000ft. Mr. F. T. Mappin, M.P., the chairman, expressed the opinion that the time had not yet arrived for the Corporation to take up the electric light, and stated that he was surprised to find how few gas stoves were used for cooking in Sheffield.

There are indications that the workmen feel themselves strong enough to ask for advance of wages in the lighter departments. The latest to move are the razor blade makers, who are agitating for an increase to the extent of 10 per cent. The dispute in the file trade is gradually being settled by things remaining as they were. The employers are not insisting on the 10 per cent. reduction, but while keeping their men on do not enter into arrangements for continued employment at the old price.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

A DECIDED want of animation has been apparent in the Cleveland pig iron trade during the past week, and prices are about 3d. per ton lower. A majority of the makers are indifferent as to fresh orders, as they have on their books enough to keep them going for the present and immediate future. They have therefore been selling only small quantities and for prompt delivery, and will only contract ahead at higher than present rates. At the market held at Middlesbrough on Tuesday last, makers quoted 40s. 3d. to 40s. 9d. per ton for No. 3 G.M.B., f.o.b. Tees, but the little business actually transacted was by merchants, and at 40s. per ton.

The quarterly meeting of the Cleveland iron market will be held on Tuesday next.

The directors of the Middlesbrough Exchange Company have issued a notice stating that the time for holding the market is from 12 to 1 o'clock, and requesting members to be punctual. They decline, however, for the present, to close the doors at noon, or to inflict a fine on those members who are late. This notice is in reply to a petition sent to the managing committee some time since, asking them to take strong measures to ensure attendance at the proper time. It is feared that the evil will not be cured by this rather mild policy.

Holders of warrants are offering them at 40s. 3d. per ton f.o.b. Tees, and will not take less.

The stock of pig iron in Messrs. Connal's Middlesbrough stores on Monday night was 81,895 tons, being 751 tons less than a week ago. The quantity of iron in their store at Glasgow at the same date was 584,564 tons.

There is a quiet demand for finished iron at previous prices. Most of the manufacturers quote ship plates £6 5s. to £6 10s. per ton; angles for shipbuilding, £5 15s.; and common bars, £6; all f.o.t. at makers' works, less 2½ per cent.

The shipments from the Tees last month were very satisfactory. The quantities were, pig iron, 75,295 tons, and manufactured iron and steel, 32,896 tons. In February the exports were, pig iron, 53,828 tons, and manufactured iron and steel, 26,123 tons. Last month the bulk of the pig iron was sent to the following parts:—Scotland, 25,715 tons; Wales, 3510 tons; Newcastle, 3435 tons; France, 12,170 tons; Germany, 11,375 tons; Holland, 6142 tons; Belgium, 4965 tons; and Spain, 1880 tons.

At the adjourned meeting of the council of the Durham Miners' Association, held at Durham on Saturday last, it was agreed that a demand should be made to the Durham Coalowners' Association to establish ten hours per diem as the recognised time for drawing coal throughout the county. At present eleven hours are worked.

The Tees Conservancy Commissioners, at a meeting held at Stockton on Monday last, decided to widen the river between Stockton Bridge and Messrs. Richardson, Duck, and Co.'s shipyard, at a cost of £5130. This is the part of the river which is opposite the most thickly populated part of the town.

A meeting of the Board of Conciliation and Arbitration was held at Darlington on the 29th ult., to receive the reply of the men to the proposals made at the previous meeting held at Durham. These proposals had reference to the wages question, the restriction of output, and the adoption of the sliding scale. The main points were as follows: (1) That the present rate of wages—7s. 9d. per imperial ton for puddling and proportionate mill wages—continue in force until September 29th, and from that date that Mr. Dale's sliding scale of 1s. 6d. above shillings for pounds should come into force till the end of the year. (2) That the employers, at the request of the operatives, consent to limit work at all mills and forges to ten shifts per man till the end of the year, provided that the arrangement be carried out at all works in the North of England, whether connected with the Board or not. (3) That the object desired to be effected is a lessened production of plates, bars, and angles, and to ascertain if such a reduced make of iron can be disposed of at a higher relative selling price than heretofore in the joint interest of employers and operatives. (4) That any departure from the arrangement by any of the works to exonerate all employer-members from carrying out or continuing this concession. It was decided that the ascertainment of the net selling prices of finished iron by the accountants should be limited to two months instead of three, as at present. The operative delegates reported that the men were almost unanimous in favour of the above four resolutions. After some debating the following resolution was adopted:—"That the minutes of the Board, as made at Durham and delivered to the various lodges, be now adopted, and that from and after April 9th the new system of working be adopted at all the ironworks in the North of England."

The accountant's certificate issued under the new sliding scale in the Northumberland coal trade, reduces the wages of underground workmen and banksmen 1¼ per cent.

The prospectus for the new chemical company in process of formation at Middlesbrough has just been issued. The capital will consist of £250,000 in 12,500 shares of £20 each, but only 10,000 shares will be issued at present. The works of Dr. Sadler at Middlesbrough, Stockton, Carlton, Ulverston, and Portsmouth, have been acquired for £93,500. Dr. Sadler will be managing director for the company, and takes 2500 shares in part payment of the purchase money. The company will manufacture Turkey red, and intend to bore for salt, and to manufacture soda by the ammonia process, besides carrying on the present manufactures. Mr. C. F. H. Bolckow is chairman of the company, and the other directors are Mr. T. Fry, M.P., Mr. W. Hanson, Mr. R. Dixon, and Mr. G. Dyson.

The Cleveland ironmasters' returns for March were published on Tuesday night. They show that 120 furnaces are in blast, eighty-five on Cleveland iron and thirty-five on other kinds. The make of Cleveland pig iron during the month was 158,129 tons, being 14,262 tons more than in the previous month. The output of hematite or basic iron was 78,866 tons, being an increase of 10,243 tons. The stocks show a net decrease of 504 tons. Makers' stocks have increased 7974 tons, but there is a decrease in the other stores of 8478 tons. Makers' stocks amount to 197,711 tons, and makers' stores to 21,015 tons. The North-Eastern stores amounted at the end of the month to 6645 tons, and Connal's stores were 81,870 tons.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow warrant market has been slacker than usual this week, and prices have touched the lowest point since the beginning of the year. The foreign trade is still short of expectation. Not merely are the shipments below the mark, but the prices obtained for the iron are barely remunerative, so far at least as the business with the United States is concerned. The past week's exports of Scotch pig were smaller than for a long time back, and the total shipments to date are 8000 tons below those at the same date last year. There is no lack of activity in the home trade, and it is upon it that the maintenance of business chiefly depends; but the great abundance and the cheapness of iron tends greatly to limit the profitableness of the trade. The decrease in the stocks in the warrant stores continues at the rate of fully 1000 tons per week.

Business was done in the warrant market on Friday forenoon at 47s. 2d. to 47s. cash, and 47s. 4d. to 47s. 3d. one month, the afternoon transactions being at 47s. 1d. to 47s. 0½d. cash, and 47s. 3d. to 47s. 2½d. one month. On Monday transactions took place at from 47s. 1d. to 47s. 1½d. cash. Tuesday's market was flat, at 47s. 1½d. to 47s. 0½d. cash. Business was done on Wednesday down to 46s. 10½d. cash. Thursday being a Church holiday in Glasgow, no market was held on that day.

Makers' prices are about 6d. per ton easier, as follows:—Gartsherrie, f.o.b., at Glasgow, per ton, No. 1, 62s.; No. 3, 55s.; Coltness, 64s. 6d. and 55s.; Langloan, 64s. 6d. and 55s.; Summerlee, 61s. 6d. and 51s. 6d.; Chapelhall, 61s. and 54s.; Calder, 62s. 6d. and 53s.; Carnbroe, 55s. 6d. and 50s.; Clyde, 51s. 9d. and 49s. 9d.; Monkland, 49s. and 47s.; Quarter, 48s. 6d. and 46s. 6d.; Govan, at Broomielaw, 49s. and 47s., Shotts, at Leith, 64s. 6d. and 56s.; Carron, at Grangemouth, 53s.—specially selected, 58s. 6d.—and 48s. 6d.; Kinneil, at Bo'ness, 48s. 6d. and 47s. 6d.; Glengarnock, at Ardrossan, 55s. and 49s. 6d.; Eglinton, 49s. 6d. and 47s.; and Dalmellington, 50s. and 49s.

All departments of the manufactured iron trade are busy. Foundries and malleable works are as active as possible, the latter employing double shifts of workmen. Iron merchants agree in the statement that a large business is being done, but that the prices leave a comparatively small margin of profit. The engineering trades have orders that will keep them busy for a long time.

The coal trade in the West of Scotland is in a more satisfactory condition than is usual at the present season. We have now reached the time when it is customary for prices to recede; but the briskness that has prevailed has enabled coalmasters to maintain quotations up to within a few pence per ton of the highest figures received during the winter. The shipping trade has been active, and the inland demand for use at public works and private houses is keeping up remarkably well. Coalmasters, indeed, have found business so good that they have for the most part been in a position to keep their colliers steadily employed at full time without any necessity for interfering with their wages. These remarks apply only to the western mining districts. A different state of matters exists in the east, where the employers were induced several weeks ago to reduce the miners' wages. The men are of opinion that this was done without sufficient reason, an opinion which I find is shared by colliery owners in the west. At the same time, it must be conceded that the masters in Fife and Clackmannan and the Lothians know their own business best. At a meeting of the Executive Board of the Fife and Clackmannan Miners' Association, it has been resolved to send £100 to the assistance of the men on strike in the Lothians against the reduction of 10 per cent. With reference to the proposed restriction of coal in Fife and Clackmannan, delegates reported that they had placed the result of the recent ballot before their men, that the majority were in favour of abiding thereby, and putting in their warnings individually, giving the employers fourteen days' notice before commencing the restriction of labour to five days per week. It may be stated that the rules under which the miners of Fife and Clackmannan are at present employed require them to work at least eleven days in the fortnight, and the employers have resolved unanimously to allow of no departure from the conditions of employment; and what the men propose is to give two weeks' notice from Saturday, first that they are to quit their masters' employment, intimating at the same time that they will be ready to continue in their service after the expiry of the fortnight, on condition that the rules in question are withdrawn. By this means they hope to be able legally to enter upon the proposed restriction of work. The result of the ballot alluded to above was that 2268 men voted for restriction and 168 for working as at present. It is now nearly four weeks since the strike began in the Lothians, and it is reported that many of the miners' families are suffering from poverty. As regards the coal trade, an improved tone prevails in Fife, and the continental demand seems to be getting better. If we take Burntisland, for example, as an instance of what is doing in the shipping trade, we find that the coal exports during March show an increase of fully 20,000 tons over that of the corresponding month of last year. But the cheap rates which prevail for coal at Burntisland and other Fife ports is attracting vessels from the south side of the Firth of Forth, the result being that a considerable decrease is noted in the shipments at Leith. A fair shipping business has, however, been done at Bo'ness and Grangemouth.

The Associated Ironmoulders of Scotland have just held their tenth annual meeting at Edinburgh, when it was reported that the membership was 5400, and the annual income £13,000.

During March there were 21 new vessels launched from Clyde shipbuilding yards, with an aggregate tonnage of 29,259, as compared with 11 vessels of 14,500 tons in the same month last year. The output of the three months is 50 vessels, with an aggregate tonnage of 80,759, against 45 vessels and 66,400 tons in the corresponding quarter of 1882. There are now about 145 vessels on the stocks.

WALES AND ADJOINING COUNTIES

(*From our own Correspondent.*)

THE iron and coal trades are in a moderately satisfactory condition. Iron and steel prices rule low, and there is not much briskness visible, except in one or two quarters, where some large colonial orders are booked. There is, however, a good deal of expectancy aroused regarding the Indian trade, as it is certain that a very large tract is about to be railed, and that the mills of England and Wales will be in full drive for a length of time in order to supply. I am told by an ironmaster that upon this head there can be no doubt. It is only a question of a short time, and if buyers are wise they will put in for business now that prices are low. I confidently look for a better tone in the market. The chief business done of late has been in American orders. Last week Newport shipped 1500 tons to Baltimore, 410 to Tampico, and 1400 tons to Naples. A cargo of 550 tons also left Cardiff for India.

There is no change for the better in tin-plate, and the only cargo of any note that left here last week was 200 boxes for Baltimore. The destitution amongst the tin works' district is great, and business cannot be expected to improve until spring trade is more vigorously advanced. Some degree of benefit may, however, be expected to accrue from the expected activity in the iron trade. It is certain that a great and radical change must be brought about, and it is as absurd for tin-plate workers to cling to old conditions as it would have been for ironmasters to have persisted in making iron rails when the demand for steel was becoming general. If the country expects a cheaper coke plate than 16s. or 17s., which are scarcely profitable prices, then a lower priced article must be made, and the means resorted to, cutting down wages, lessening cost, or as may be practicable. Lessening output was [illegible] with a certain amount of benefit, but that had its day; then came failures, but this told for the better during a month or two. Now the whole trade is again flat, and in a great measure because makers are contending against the demand for a cheaper plate. When thousands are suffering, it is time that some remedial measures should be adopted.

Steam and house-coal prices are firm, and the latter are stiff at 9s. 6d. f.o.b. As for steam, though exports show a considerable lessening, owing to adverse winds and colliers' holidays, the demand is well sustained, and I hear of several instances where coalowners are too full of orders to book any more.

This is a week of considerable interest and anxiety, as the fate of several important Bills will be sealed. The Barry supporters are sanguine, but judging from the mass of evidence collected and the array of counsel, the struggle will be a severe one, and one not easily decided. Mr. Tones, contractor of the Rhondda and Swansea Bay line, has commenced operations in the Avon Valley.

As I anticipated, the Forest of Dean colliers have resumed work, and the strike is at an end. The arrangements made were those proposed by the masters—5 per cent. reduction, and 5 per cent. left to arbitration. The Rhondda colliers aided the Forest men with nearly £100.

Patent fuel is in good demand, and most of the works near Cardiff have got full orders. Swansea too is particularly brisk in this trade, and sent away over 5000 tons last week.

Some reports are current of slackness in the iron ore trade. Judging from the stocks received at Newport and Cardiff last week there is not much cause for complaint. The total received at Cardiff was 18,000 tons, and at Newport 1980 tons.

Coal exports owing, as stated, to holidays and winds, showed a remarkable change. Instead of a total of 200,000 tons, which has been frequently reached, the total from Wales last week amounted to 156,000 tons.

The new sinkings above Cefn Pennar, in the Aberdare, by Mr. Martin, for the Powell Duffryn, and those in the Tredegar district are getting on remarkably well. "Harris's Deep Navigation" is doing better; Messrs. Brown and Adams calculate upon an output of 2000 tons daily from their colliery.

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.

27th March, 1883.

1542. Pans for Melting Pitch, &c., J. B. Stewart, Liverpool.
1543. Calendars, J. C. Sellars, Birkenhead.
1544. Bearings for Spindles, D. Skeoch, Stewarton.
1545. Rotary Engine, H. A. Bonneville.—(*J. N. Forbes, Lawrence, U.S.*)
1546. Locomotives, H. Bonneville.—(*J. N. Forbes, U.S.*)
1547. Paper Bags, T. and J. Bibby, J. Baron, and J. Duerden, Burnley, and W. Baron, Rochdale.
1548. Mordanting Fabrics, &c., C. F. Cross and E. J. Bevan, London.
1549. Shears for Clipping Horses' Tails, T. W. White and F. Awdas, London.
1550. Brewing Apparatus, W. and T. S. Bucknall, Kidderminster.
1551. Railway Brakes, J. Armstrong, New Swindon.
1552. Aerial Navigation, B. W. Maughan and S. D. Waddy, London.
1553. Metals, &c., J. Lewthwaite, Halifax.
1554. Liquid Compound for Extinguishing Fires, C. D. Abel.—(*E. F. Neveu, Paris.*)
1555. Extracting Cobalt, &c., from their Ores, J. Imray.—(*H. Herrenschmidt and M. Constable, Sydney.*)
1556. Electrical Accumulators, H. E. Newton.—(*D. Monneir, Paris.*)
1557. Producing Carbo-silicium, &c., J. W. Gatehouse, Bath.
1558. Lock Nuts, E. and A. E. Gilbert, Dundee.
1559. Opening, &c., Doors, J. Stones, Ulverston, and T. Kirby, Barrow-in-Furness.
1560. Steam Pump, J. Hodgkin.—(*M. Neuhaus, Berlin.*)
1561. Fluid Meters, W. R. Lake.—(*J. Thomson and C. C. Barton, U.S.*)
1562. Sewing Machine, S. Pitt.—(*L. B. Miller and P. Diehl, Elizabeth, U.S.*)
1563. Ventilating Railway Tunnels, C. E. Walter, Yangley.
1564. Disintegrating Machines, W. R. Lake.—(*S. and E. B. Dodson, New York, U.S.*)
1565. Separating Metals by Electrolysis, L. Elmore.—(*G. J. Atkins, Brooklyn, U.S.*)

28th March, 1883.

1566. Cleaning Knives, R. Wallwork, Manchester.
1567. Preventing Down-draught in Chimneys, W. Lord, Middlesbrough.
1568. Saddles for Bicycles, J. Brooks, Birmingham.
1569. Incrusting Metal to Represent Sculpture, A. Baillif, Paris.
1570. Ventilators, &c., R. A. Hunter, Dublin.
1571. Fire-arms, &c., H. Piper, Liége.
1572. Fulling Machines, A. Roger, Paris.
1573. Shuttles, T. Brooks and T. Tweedale, Crawshawbooth.
1574. Lavatories, &c., A. F. Morrison, Manchester.
1575. Electro-magnetic Printing Apparatus, W. P. Thompson.—(*H. V. Hoevenbergh, U.S.*)
1576. Electro-magnetic Printing Telegraphs, W. P. Thompson.—(*H. V. Hoevenbergh, U.S.*)
1577. Alumina, W. P. Thompson.—(*J. D. Darling, U.S.*)
1578. Furnaces for Burning Cement, P. M. Justice.—(*C. Dietzsch, Malstatt.*)
1579. Horizontal Boilers, P. Jensen.—(*W. Tesch, Stockholm.*)
1580. Fastenings for Gloves, &c., E. Neupert, Prussia.

29th March, 1883.

1581. Displaying Advertisements, J. Coxen, London.
1582. Cards for the Reception of Silk, J. H. Johnson.—(*E. Vaguez-Fessart, Paris.*)
1583. Double-ribbed Warp Looms, J. D. Harris and A. Shuttlewood, Leicester.
1584. Distilling Glycerine, F. J. O'Farrell, Dublin.
1585. Heating Apparatus, W. P. Thompson.—(*C. Launay, Paris.*)
1586. Dating, &c., Tickets, J. B. Edmondson and J. Carson, Manchester.
1587. Coupling, &c., Railway Carriages, J. T. Leighton, Edinburgh.
1588. Ring Spinning Machinery, E. de Pass.—(*J. Imbs, Paris.*)
1589. Dyeing Cotton, &c., W. H. Spence.—(*A. F. Chesnais, France.*)
1590. Check Fishing Reel, A. Carter, London.
1591. Feeding, &c., Sheets of Paper to Platen Printing Machines, A. Godfrey, Stockport.
1592. Stoves, L. C. Besant, Greenock.
1593. Steam Traps, J. Gillies, Glasgow.
1594. Lamps, A. Chamberlain and G. Hookham, Birmingham.
1595. Feed-water Heaters, J. Withinshaw, Birmingham.
1596. Ice-making Machines, J. Johnson.—(*T. Rose, U.S.*)
1597. Wire Fencing, W. J. Smith, Inverness.
1598. Reservoir Pens, B. S. Cohen.—(*G. A. Ogle, U.S.*)
1599. Smoke Preventing Grates, A. Andresen, London.
1600. Fastenings for Gloves, F. J. Martin, London.
1601. Tanning Hides, W. R. Lake.—(*B. D. Hyam and W. H. Howell, Washington, U.S.*)

30th March, 1883.

1602. Utilising Slags, C. Pieper.—(*C. Scheibler, Berlin.*)
1603. Boring Machine Cutters, J. Wade, Halifax.
1604. Heating, &c., Fluids, W. Schönheyder, London.
1605. Globes for Gas Burners, A. Edwards, London.
1606. Spring Scales, C. Pieper.—(*E. Ubrig, Berlin.*)
1607. Communicating Apparatus, A. Jordan, London.
1608. Gelatine-bromide Film Paper, R. H. Brandon.—(*A. C. A. Thiébaut, Paris.*)
1609. Fire Alarms, I. Thomas, Aberdare.
1610. Preventing the Entrance of Wind, &c., under Doors, D. B. Gibson, Manchester.
1611. Manufacture of Tissues, H. J. Haddan.—(*H. Kahls, Chemnitz.*)
1612. Lubricating Journals, W. Mitchell, New York.
1613. Securing Rails in their Chairs, H. Ayton, Seaton Delaval, and E. Ayten, Headon-on-the-Wall.
1614. Evaporating Liquids, &c., J. H. Johnson.—(*J. A. Saladin, Paris.*)
1615. Saws, W. R. Lake.—(*D. Brigham, Melbourne.*)
1616. Pneumatic Signals for Railways, E. Chase, U.S.
1617. Electric Lamps, W. R. Lake.—(*C. Dion, Paris.*)
1618. Electro-magnets, A. M. Clark.—(*L. C. A. J. G. d'Arlincourt, Paris.*)

31st March, 1883.

1619. Puddling Furnaces, J. Imray.—(*P. J. Dujardin and J. B. F. Fredureau, Paris.*)
1620. Voltaic Arc Lamps, B. Mills.—(*O. A. Moses, U.S.*)
1621. Feeding Thrashing Machines, E. G. Rock.—(*H. Roxburgh and J. Crawford, New Zealand.*)
1622. Carbonate of Strontium, &c., W. L. Wise.—(*Dr. H. Grouven, Leipzig.*)
1623. Electric Arc Lamps, F. M. Newton, Belfast.
1624. Fastenings for Gloves, &c., J. Hinks and F. R. Baker, Birmingham.
1625. Apparatus to Nullify the Effects of Collisions at Sea, W. N. Smith and R. R Swann, London.
1626. Controlling Railway Points, A. W. Pigott, Gateshead.
1627. Overlaying Attachments for Sewing Machines, W. Scott, jun., and D. S. Morrison, Dundee.
1628. Crucibles, J. C. Waterhouse, Wakefield.
1629. Hoists, &c., J. Mangnall, Eagley.
1630. Underground Paint, F. Wirth.—(*O. Fischer, Karlsruhe.*)
1631. Traction Engines, W. Wilkinson, Wigan.
1632. Electric Signalling Apparatus, W. H. Preece, Wimbledon, and W. E. Langdon, Derby.
1633. Lamps, Sir J. N. Douglass, Dulwich.
1634. Improved Game, J. J. Ridge, Enfield.
1635. Connecting, &c., Railway Vehicles, R. Hill and E. Cockerill, Heywood.
1636. Actuating Fans, A. J. Boult.—(*P. Schwarz and P. Treutler, Berlin.*)
1637. Taps, W. A. Todd, Folkingham.
1638. Corking Bottles, J. J. H. Schultz, Hamburg.
1639. Dynamo-electric Machinery, S. P. Thompson, Bristol.
1640. Lighting Lamps, G. W. von Nawrocki.—(*P. Richter, Potsdam.*)

2nd April, 1883.

1641. Converting Electricity into Mechanical Power, C. A. Mulholland, Nottingham.
1642. Injectors, A. Budenberg.—(*Messrs. Schaffer and Budenberg, Buckau-Magdeburg.*)
1643. Latches, &c., F. J. Biggs, London.
1644. Working Secondary Batteries, J. S. Sellon, London.
1645. Telegraphic Wire, L. Elmore.—(*W. B. Hollingshead, New York, U.S.*)
1646. Electric Lighting, J. L. Huber, Hamburg.
1647. Electrical Safety Plugs, C. V. Boys, Wing, and H. H. Cunynhame, London.
1648. Laces, R. Paton, Johnstone.
1649. Combing Wool, &c., H. W. Whitehead.—(*C. F. Alexander, Philadelphia, U.S.*)
1650. Photographic Shutters, R. Reynolds and F. W. Branson, Leeds.
1651. Concentrating Sulphuric Acid, W. P. Thompson.—(*W. West, Denver, U.S.*)
1652. Electric Safety Lamps, T. Coad, London.
1653. Rendering Ships Unsinkable, W. Morris, London.
1654. Clasp for Albums, L. Groth.—(*A. Pflüger, Berlin.*)
1655. Turbines, F. H. F. Engel, Hamburg.
1656. Protecting Ships when Leaky, F. H. F. Engel.—(*A. Tuchtfeldt, Hamburg.*)

Inventions Protected for Six Months on Deposit of Complete Specifications.

1545. Rotary Engine, H. A. Bonneville, London.—A communication from I. N. Forbes, Lawrence, U.S.—*27th March*, 1883.
1546. Locomotives, H. A. Bonneville, London.—A communication from I. N. Forbes, Lawrence, U.S.—*27th March*, 1883.
1562. Sewing Machines, S. Pitt, Sutton.—A communication from L. B. Miller and P. Diehl, Elizabeth, U.S.—*27th March*, 1883.
1564. Disintegrating Machines, W. R. Lake, London.—A communication from S. and E. B. Dodson, New York, U.S.—*27th March*, 1883.
1580. Fastenings for Gloves, &c., E. D. J. Neupert, Ottensen.—*28th March*, 1883.
1608. Gelatino-bromide Film Paper, R. H. Brandon, Paris.—A communication from A. C. A. Thiébaut, Paris.—*30th March*, 1883.
1612. Lubricating Journals, W. G. Mitchell, New York.—*30th March*, 1883.
1616. Pneumatic Signals for Railways, E. M. Chase, Boston, U.S.—*30th March*, 1883.

Patents on which the Stamp Duty of £50 has been paid.

1189. Combination of Rail and Wheel, H. Wedekind, London.—*19th March*, 1880.
1332. Orreries, &c., I. H. Morley, Nottingham, and R. C. Hopper, Birmingham.—*31st March*, 1880.
1396. Lighting Lamps, J. and J. Hinks, Birmingham—*6th April*, 1880.
1441. Sanitary Appliances for Sinks, &c., C. T. and C. Brazier, London.—*8th April*, 1880.
1580. Dynamo-electric Machines, E. P. Alexander, London.—*17th April*, 1880.
1321. Digging Peat, &c., H. Simon, Manchester.—*31st March*, 1880.
1345. Turning, &c., Wood, W. R. Lake, London.—*1st April*, 1880.
1361. Portable Drilling Machines, A. C. Kirk, Glasgow.—*2nd April*, 1880.
1340. Thrashing Machines, C. Middleton, East Dereham, and P. Everitt, Great Ryburgh.—*1st April*, 1880.
1344. Damping Woven Fabrics, W. R. Lake, London.—*1st April*, 1880.
1346. Torpedo Boats, W. R. Lake, London.—*1st April*, 1880.
1405. Tip Trucks, &c., S. Geoghegan, Dublin.—*6th April*, 1880.
1430. Breaking up Wood Burs, H. Simon, Manchester.—*8th April*, 1880.

Patents on which the Stamp Duty of £100 has been paid.

1380. Drying Apparatus, W. A. Gibbs, Sewardstone.—*30th March*, 1876.
1335. Bottling Beer, A. W. Gillman and S. Spencer, London.—*29th March*, 1876.
1397. Spinning, &c., Cotton, J. L. Taylor and R. Ramsden, Bolton.—*31st March*, 1876.
1366. Weirs or Annicuts, F. Applegath, London.—*30th March*, 1876.
1405. Pressure Gauges, A. Allan, jun., Scarborough.—*1st April*, 1876.
1489. Horseshoe Nails, H. J. Haddan, London.—*7th April*, 1876.
1764. Automatic Signal Buoy, A. M. Clark, London.—*26th April*, 1876.

Notices of Intention to Proceed with Applications.

(*Last day for filing opposition*, *20th April*, 1883.)

5603. Tentering, &c., Machines, J. Ashworth, Rochdale.—*25th November*, 1882.
5609. Cutting-up Sugar Cane, &c., C. D. Abel, London.—Com. from. A. Perret.—*25th November*, 1882.
5610. Block Signalling, &c., on Railways, F. Swift, West Drayton, and A. J. M. Reade, Slough.—*25th November*, 1882.
5619. Filling and Closing Bottles, J. Phillips, London.—*27th November*, 1882.
5621. Preventing Injuries, Accidents, or the Destruction of Steam Boilers, A. J. Smith, London.—*27th November*, 1882.
5625. Telephonic Apparatus, J. B. Spence, London, and J. E. Chaster, Southport.—*27th November*, 1882.
5626. Metal Cisterns and Syphons, H. Sutcliffe, Halifax.—*27th November*, 1882.
5630. Weaving Piled Fabrics, J. Holt, Bolton.—*27th November*, 1882.
5634. Toys, H. H. Lake, London.—A communication from J. N. Gifford, jun.—*27th November*, 1882.
5637. Fret-saw Machines, R. D. Sanders, Acton.—*27th November*, 1882.
5651. Remedy for Whooping Cough, P. F. Vandersteenstraaten, London.—*28th November*, 1882.
5656. Arranging Steam Boiler with Rapid Circulation, H. Matheson, Barnes.—*28th November*, 1882.
5662. Raising and Lowering Carriage Windows, E. Clennett, West Hartlepool.—*28th November*, 1882.
5663. Communicating Apparatus, W. Sharpe, Rastrick.—*28th November*, 1882.
5665. Twisted Ribs for Gun Barrels, W. James, Birmingham.—*28th November*, 1882.
5669. Measuring, &c., Electric Currents, J. Blyth, Glasgow.—*29th November*, 1882.
5670. Dividing, &c., Dough to Form Loaves, J. Melvin, Glasgow.—*29th November*, 1882.
5680. Constructing Steps of Flights of Stairs, H. Doulton, London.—*29th November*, 1882.
5696. Colouring Matters, J. Imray, London.—A communication from La Société Anonyme des Matières Colorantes et Produits Chimiques de St Denis and Messrs. Roussin & Rosenstiehl.—*30th November*, 1882.
5699. Sieve, G. W. von Nawrocki, Berlin.—A communication from L. Hirschfeldt.—*30th November*, 1882.
5724. Clips and Washers for Railway Fastenings, E. G. Sheward, Richmond, and W. E. Jones, London.—*1st December*, 1882.
5729. Steam Fire-engines, G. Witte, Berlin.—*1st December*, 1882.
5755. Fencing, G. Greig, Edinburgh, and J. Leck, Brora.—*2nd December*, 1882.
5797. Primary Voltaic Batteries, T. J. Jones, London.—*5th December*, 1882.
5798. Refrigerating Machinery, W. H. Wood and G. Richmond, New York, U.S.—*5th December*, 1882.
5816. Governors for Engines, F. J. Burrell, Thetford.—*6th December*, 1882.
5817. Milling Apparatus, J. H. Carter, London.—*6th December*, 1882.
5932. Substitute for Linseed Oil, P. G. Oster, Prussia.—*12th December*, 1882.
6168. Joining the Ends of Leather Belts, &c., H. H. Lake, London.—A communication from A. Johnston.—*26th December*, 1882.
65. Motive-power Engines, C. Ingrey, Fulham, and W. Adlam, Clifton.—*4th January*, 1883.
70. Crank and other Shafts, G. Allibon and T. Turton, Liverpool.—*5th January*, 1883.
658. Bedsteads, &c., G. Lowry, Salford.—*6th February*, 1883.
875. Reducing Metals from their Ores or Chemical Compounds, J. Clark, London.—*17th February*, 1883.
920. Combustion of Fuel in Grates, H. W. Davidson, Clapton, and J. Speir, London.—*20th February*, 1883.
954. Sliver or Card Can Rings, J. Rothwell and G. McMillan, Farnworth.—*21st February*, 1883.
1046. Holders for Knive Blades, &c., J. H. Johnson, London.—A communication from J. Reckendorfer.—*27th February*, 1883.
1047. Attachment for Spinning Frames, A. Gilmore, Keady.—*27th February*, 1883.
1059. Telephonic Apparatus, L. J. Crossley and W. Emmott, Halifax.—*27th February*, 1883.
1468. Lasting Machines, P. M. Justice, London.—A communication from J. E. Matzeliger, C. H. Delnow, M. S. Nichols, and G. S. Forbush.—*20th March*, 1883.

(*Last day for filing opposition*, *24th April*, 1883.)

5653. Loom Pickers, H. Tetlow, Miles Platting, and J. Holding, Lower Broughton.—*28th November*, 1882.
5674. Glazing, &c., Paper and other Fabrics, S. Wells, London.—*29th November*, 1882.
5675. Mowing, &c., Machines, R. Davison, Manchester, and F. H. Hallard, Leigh.—*29th November*, 1882.
5683. Checking Apparatus, H. T. Davis, London.—*29th November*, 1882.
5693. Telegraphing Apparatus, W. L. Hunt, London.—Com. from R. M. Hunter.—*30th November*, 1882.
5698. Dyeing Aniline Colours, L. Heppenstall, jun., Milnsbridge.—*30th November*, 1882.
5701. Securing Nuts on Bolts, S. Watkins, Wolverhampton.—*30th November*, 1882.
5707. Wheels, J. Simpson and S. T. Fawcett, Leeds.—*30th November*, 1882.
5708. Paper Pulp, &c., P. Jensen, London.—Com. from T. P. Aktiebolag.—*30th November*, 1882.
5712. Dredging Apparatus, G. E. Vaughan, London.—Com. from S. Meinesz.—*30th November*, 1882.
5726. Winning Coal or Rock, E. Warre and T. W. Salmon, Eton.—*1st December*, 1882.
5728. Ploughs, H. J. Haddan, London.—A communication from F. W. Unterilp.—*1st December*, 1882.
5730. Surveying, &c., Land, A. J. Boult, London.—Com. from Dr. L. Cerebotani.—*1st December*, 1882.
5733. Stylographic Fountain Pens, M. H. Kerner, London.—*1st December*, 1882.
5735. Generating, &c., Power for Manufacturing Purposes, S. Broadbent, and S. Broadbent, jun., Tong.—*1st December*, 1882.
5739. Boots and Shoes, H. E. Randall, Northampton.—*1st December*, 1882.
5746. Treating Galvanisers' Flux, &c., H. Kenyon, Altrincham.—*2nd December*, 1882.
5754. Electrical Switch, G. W. Bayley, Walsall.—*2nd December*, 1882.
5756. Brick, Blocks, and Slabs, W. Foot, Wellington.—*2nd December*, 1882.
5761. Refrigerating Apparatus, W. R. Lake, London.—Com. from R. A. Messervey.—*2nd December*, 1882.
5775. Raising, Lowering, &c., Ships' Boats, E. J. Harland, G. W. Wolff, W. H. Wilson, and W. J. Pirrie, Queen's Island.—*4th December*, 1882.
5781. Supporting Swing Looking-glasses, &c., G. Crofts and F. Assinder, Birmingham.—*5th December*, 1882.
5810. Treating Spoil Heaps of Collieries, L. H. Armour, Gateshead-on-Tyne.—*6th December*, 1882.
5831. Confectionery Machines, W. R. Lake, London.—A communication from Messrs. Thiele and Holzhause.—*6th December*, 1882.
5876. Ventilating Buildings, T. H. Thompson, Manchester.—*9th December*, 1882.
5903. Cans or Vessels, T. S. Marriage, Reigate.—*11th December*, 1882.
5948. Iron or Metal Wedges, &c., G. Guthrie, Sunderland.—*13th December*, 1882.
5985. Polishing Jewels, &c., W. L. Wise, London.—A communication from J. T. y Urell and J. T. y Nogues.—*14th December*, 1882.
6121. Water-closets, &c., W. R. Lake, London.—A communication from C. F. Pike.—*22nd December*, 1882.
6219. Purifying Oil and Fatty Matters, W. R. Lake, London.—A communication from E. S. Dangivillé.—*29th December*, 1882.
232. Carbonate of Strontia, D. Urquhart, London.—*15th January*, 1883.
295. Treating Yarns and Covering Wires for Telegraphic, &c., Purposes, W. T. Glover and G. F. James, Manchester.—*18th January*, 1883.
620. Materials for Protecting Plants or Trees from Insects, J. Walker, Leeds.—*5th February*, 1883.
880. Arranging Clocks, &c., J. A. McFerran, Manchester.—*17th February*, 1883.
945. Tanning Leather by Electricity, L. Gaulard, London.—*20th February*, 1883.
1001. Relay Apparatus, D. J. Dunlop, Port Glasgow.—*24th February*, 1883.
1562. Sewing Machines, S. Pitt, Sutton.—Com. from L. B. Miller and P. Diehl.—*27th March*, 1883.
1608. Gelatino-bromide Film Paper for Photographic Negatives, R. H. Brandon, Paris.—A communication from A. C. A. Thiébaut.—*30th March*, 1883.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the* *30th March*, 1883.)

4694. Generating, &c., Electricity, E. Edwards, London, A. F. St. George, Redhill, and H. L. Phillips, Hornsey.—*3rd October*, 1882.
4695. Electric Lamps, E. Edwards, London, and A. F. St. George, Redhill.—*3rd October*, 1882.
4704. Metallic Frames for Bedsteads, &c., B. J. La Mothe, New York, U.S.—*3rd October*, 1882.
4712. Electrical Bells, &c., B. W. Webb and H. P. F. and J. Jensen, London.—*3rd October*, 1882.
4733. Extracting the Constituent Principles of Fatty Bodies, W. H. Beck, London.—*4th October*, 1882.
4742. Hoes, W. Edwards, Wolverhampton.—*5th October*, 1882.
4760. Hoists for Mills, &c., S. Jones, Warrington.—*6th October*, 1882.
4764. Electrical Apparatus, A. Reckenzaun, Leytonstone.—*6th October*, 1882.
4769. Treating Certain Carbonaceous Minerals for Obtaining Oil, &c., A. Neilson and A. C. Thomson, Renfrew.—*7th October*, 1882.
4778. Telephones, H. B. T. Strangways, London.—*7th October*, 1882.
4780. Electric Lamps, S. F. Walker and F. G. Olliver, Cardiff.—*7th October*, 1882.
4782. Elevators, W. S. Brice, Liverpool.—*7th October*, 1882.
4802. Preventing Casks or Barrels from becoming Foul, W. H. Beach, Woodfield.—*9th October*, 1882.
4805. Elastic Terry Web, J. Swann, sen., Nottingham.—*9th October*, 1882.
4807. Self-levelling Sleeping Berths, W. R. Lake, London.—*9th October*, 1882.
4827. Treating Steel Ingots before Rolling, H. J. Kennard, London.—*11th October*, 1882.
4855. Hydrogen Gas, S. Pitt, Sutton.—*12th October*, 1882.
4859. Bicycles, &c., G. W. von Nawrocki, Berlin.—*12th October*, 1882.
4867. Washing Wool, &c., W. H. Greenwood, Bradford, and C. Hoyle, Keighley.—*13th October*, 1882.
4869. Electric Lighting, W. Strickland, Woodford.—*13th October*, 1882.
4901. High-speed Engines, P. W. Willans, Thames Ditton, and M. H. Robinson, Hampton Wick.—*14th October*, 1882.
4947. Casting Pig Metal, J. T. King, Liverpool.—*18th October*, 1882.
4969. Inverted Direct-acting Marine Engines, W. Allan, Sunderland.—*18th October*, 1882.
4981. Regulating the Pressure or Flow of Illuminating Gas, &c., W. Key, Glasgow.—*19th October*, 1882.
5052. Radial Axle-boxes, F. W. Webb, Crewe.—*24th October*, 1882.
5071. Sugar, W. R. Lake, London.—*24th October*, 1882.
5159. Recovering Tar, &c., from the Volatile Products of Coke Furnaces, J. Wetter, New Wandsworth.—*30th October*, 1882.
5179. Sewing Machines, G. Browning, Glasgow.—*31st October*, 1882.
5512. Barbed Wire, O. W. Malet, London.—*20th November*, 1882.
5740. Effecting Rope Attachments, &c., C. M. E. Kortüm, Wolverhampton.—*1st December*, 1882.
5815. Furnaces, O. D. Orvis, New York, U.S.—*6th December*, 1882.
5939. Removing Grease, &c., from Feed-water, A. M. Clark, London.—*12th December*, 1882.
6047. Bi-chromates, J. H. Johnson, London.—*18th December*, 1882.
6105. Electric-meters, F. H. Varley and J. R. Shearer, London.—*21st December*, 1882.
6157. Fastenings for Gloves, &c., G. Capewell, Birmingham.—*23rd December*, 1882.
6225. Glass Bottles, J. S. Davison, Sunderland.—*30th December*, 1882.
12. Toilet Apparatus for Ships and Vessels, H. J. Haddan, London.—*1st January*, 1883.
69. Welding Boiler and other Shells, S. Alley Glasgow.—*5th January*, 1883.
78. Electric Fire-alarm Apparatus, W. C. Gordon, London.—*5th January*, 1883.
103. Producing Designs on Glass, &c., D. Reich, Berlin.—*8th January*, 1883.
217. Working, &c., Secondary Batteries, J. S. Sellon, London.—*13th January*, 1883.
227. Preserving Milk, H. W. L. O. von Roden, Hamburg.—*15th January*, 1883.
289. Arresting Sparks from Funnels, &c., E. de Pass, London.—*18th January*, 1883.
575. Ships' Seeeping Berths, W. R. Lake, London.—*2nd February*, 1883.

(*List of Letters Patent which passed the Great Seal on the* *31st March*, 1883.)

3746. Dyeing, &c., Hanks, S. Spencer, Radcliffe Bridge.—*5th August*, 1883.

(*List of Letters Patent which passed the Great Seal on the* *3rd April*, 1883.)

4715. Stoves and Fireplaces, J. Bateman, London.—*4th October*, 1882.
4722. Treating Fibrous Plants, &c., E. G. Brewer, London.—*4th October*, 1882.
4726. Door Lock or Latch Checks, W. A. Barlow, London.—*4th October*, 1882.
4727. Trapping Sewers and Drains, W. A. Barlow, London.—*4th October*, 1882.
4740. Call Apparatus for Telephone Lines, M. Benson, London.—*5th October*, 1882.
4743. Fastenings for Doors, &c., H. Hancock, London.—*5th October*, 1882.
4744. Converting Cast Iron into Steel, J. Bond and H. J. Whiteley, Tow Law.—*5th October*, 1882.
4753. Air Compressing and Water Pumps, J. H. Davis, London.—*6th October*, 1882.
4756. Secondary Voltaic Batteries, A. Khotinsky, London.—*6th October*, 1882.
4765. Bushing Material, W. R. Lake, London.—*6th October*, 1882.
4777. Electrical Communication on Railways, R. Tatham, Rochdale.—*7th October*, 1882.
4788. Scouring Machines, W. R. Lake, London.—*7th October*, 1882.
4808. Treating Isinglass for Clarifying Beer, &c., C. Vaux, Doncaster.—*9th October*, 1882.
4809. Secondary Batteries, R. Tatham, Rochdale, and A. Hollings, Salford.—*10th October*, 1882.
4813. Lighting by Gas, W. T. Sugg, London.—*10th October*, 1882.
4848. Bottles or Receptacles, E. P. Hawkins, London.—*12th October*, 1882.
4874. Yeast, A. M. Clark, London.—*13th October*, 1882.
4895. Horseshoes, E. E. Hewitt, Sheffield.—*14th October*, 1882.
4933. Buckles, F. J. Candy, Highfield Fen Ditton.—*17th October*, 1882.
4934. Paper Pulp, &c., H. A. Dufrené, London.—*17th October*, 1882.
4963. Grinding Mills, H. J. Haddan, London.—*18th October*, 1882.
4968. Razor Blades, W. R. Lake, London.—*18th October*, 1882.
4979. Preparing Flax, &c., C. and C. W. Murland and J. Montgomery, Annsborough.—*19th October*, 1882.
4984. Chloride of Lime, G. W. von Nawrocki, Berlin.—*19th October*, 1882.
5000. Confectionery, C. F. Müller, Magdeburg.—*20th October*, 1882.
5036. Water Purifiers, G. F. Redfern, London.—*23rd October*, 1882.
5057. Machines for Serving Rope with Yarn, J. H. Nute, New Glasgow.—*24th October*, 1882.
5106. Window-sashes, W. H. Lindsay, London.—*26th October*, 1882.
5130. Carburetting Air, H. H. Lake, London.—*27th October*, 1882.
5316. Silicious Copper, &c., J. C. Mewburn, London.—*7th November*, 1882.
5459. Sounding or Finding the Depth of the Sea, W. J. Mackenzie, Glasgow.—*16th November*, 1882.
5517. Ornamental Nails, &c., A. J. Boult, London.—*20th November*, 1882.
5658. Securing Buttons upon Leather &c., W. R. Lake, London.—*28th November*, 1882.
5709. Fastening Devices for Buttons and the like, A. J. Boult, London.—*30th November*, 1882.
6032. Shielding Velocipedists from Inclemency of the Weather, A. Tomkins, London.—*18th December*, 1882.
6146. Dynamo-electric, &c., Machines, R. Matthews, Hyde.—*23rd December*, 1882.
59. Road Traction Engines, M. Shillito, Leeds.—*4th January*, 1883.
215. Breech-loading Cannon, R. H. Brandon, Paris.—*13th January*, 1883.
219. Self-filling and Self-discharging Grapples, &c., G. F. Fuller, London.—*13th January*, 1883.
246. Preserving Alimentary Substances, C. M. Pielsticker, Kilburn.—*16th January*, 1883.
259. Drilling or Boring Rocks, &c., H. H. Lake, London.—*16th January*, 1883.

315. Cylinders for Breaking-up Fibrous Materials, J. D. Tomlinson, Rochdale.—19*th January*, 1883.
322. Treating Sewage, &c., J. Young, Kelly.—20*th January*, 1883.
392. Friction Clutches, A. M. Clark, London.—24*th January*, 1883.
408. Steam and other Pistons, A. MacLaine, Belfast.—25*th Januuary*, 1883.
441. Substitute for Hard India-rubber, &c., A. M. Clark, London.—26*th January*, 1883.
502. Vices, A. W. L. Reddie, London.—30*th January*, 1883.
530. Lubricating Certain Parts of Machinery, E. B. Petrie and W. A. Entwistle, Rochdale. — 31*st January*, 1883.

List of Specifications published during the week ending March 31st, 1883.

3246, 2d.; 3260, 2d.; 3314, 4d.; 3472, 2d.; 3500, 2d.; 3516, 6d.; 3548, 10d.; 3389, 10d.; 3624, 1s.; 3631, 6d.; 3701, 6d.; 3708, 6d.; 3713, 8d.; 3717, 6d.; 3718, 10d.; 3734, 6d.; 3743, 2d.; 3751, 1s.; 3754, 6d.; 3758, 6d.; 3759, 8d.; 3764, 8d.; 3780, 6d.; 3793, 4d.; 3798, 6d.; 3804, 6d.; 3805, 6d.; 3806, 6d.; 3810, 8d.; 3812, 6d.; 3816, 6d.; 3824, 10d.; 3825, 2d.; 3829, 6d.; 3833, 10d.; 3835, 4d.; 3836, 6d.; 3837, 6d.; 3838, 6d.; 3840, 6d.; 3841, 6d.; 3842, 4d.; 3843, 6d.; 3846, 2d; 3855, 6d.; 3856, 2d.; 3859, 8d.; 3866, 6d.; 3867, 6d.; 3869, 4d.; 3871, 6d.; 3873, 2d.; 3874, 6d.; 3876, 6d.; 3878, 6d.; 3880, 6d.; 3887, 6d.; 3899, 6d.; 3914, 6d.; 3917, 4d.; 3994, 2d.

_ Specifications will be forwarded by post from the Patent-office on receipt of the amount of price and postage. Sums exceeding 1s. must be remitted by Post-office order, made payable at the Post-office, 5, High Holborn, to Mr. H. Reader Lack, her Majesty's Patent-office, Southampton-buildings, Chancery-lane, London.

ABSTRACTS OF SPECIFICATIONS.

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

3246. Brushes for Boots and Shoes, &c., *W. H. Baynes, Bayswater.—8th July*, 1882.—(*Provisional protection not allowed.*) 2*d.*
The object is the combination of the three characters of brushing surfaces in one instrument.

3260. Stair Rods, *I. C. Morris, Manchester.—10th July*, 1882.—(*Provisional protection not allowed.*) 2*d.*
The rods are formed of wood instead of metal.

3314. Table or Stand for Bedsteads for Hospitals, &c., *T. Hansell, St. Albans.—12th July*, 1882. 4*d.*
This consists in a table or stand capable of being securely attached to a wall, bedstead, or suitable means of ensuring stability, and which can be turned up out of the way, so that room is thereby economised.

3458. Telephonic Apparatus, *J. E. Chaster, Manchester.—20th July*, 1882. 6*d.*
This relates to improvements on Reiss' telephone. The present inventor claims a telephonic apparatus in which one pole of an electro-magnet is rendered sufficiently flexible to vibrate, and is attracted by the other pole placed nearly in contact with its point of greatest vibration, the distance apart being adjusted by a screw or other device.

3472. Cowl for Chimneys, *J. Solomon, Knightsbridge.—21st July*, 1882.—(*Provisional protection not allowed.*) 2*d.*
This consists of a cowl having a number of apertures which are provided with doors, shutters, valves, screens, slides, or wings attached by levers and guides, which doors, shutters, valves, screens, slides, or wings are connected, each one to the one facing it, so that the closing one opens that directly opposite it, thereby excluding the least draught or wind.

3500. Convertible Shirt Fronts and Cuffs, *G. W. von Nawrocki, Berlin.—22nd July*, 1882.—(*A communication from Messrs. Muller and Sussmann, Berlin.*—(*Provisional protection not allowed.*) 2*d.*
This consists in making shirt fronts so that they can be reversed if required, and also adapting them for use as cuffs.

3516. Construction of Surgical Supports, Splints, &c., *H. Hides, Surbiton.—25th July*, 1882.—(*A communication from E. Porteus, Antwerp.*) 6*d.*
The object is the production of a moulded or otherwise shaped ambulance support or bed rest moulded to the human form by the application of prepared felt, pulped or other fibrous materials, metal, wood, cane, or other fibrous materials suitable for making surgical splints, &c.

3520. Arc Electric Lamps, *A. L. Lineff, Wilmington-square.—25th July*, 1882. 6*d.*
This relates to improvements in arc lamps, the objects of which are:—(1) Automatic feeding of the carbons; (2) the avoidance of clockwork or mechanism; (3) the construction of a lamp to work with continuous or alternate currents; and (4) one in which the current can be transferred to other pairs of carbons on the consumption of the first pair. The regulation of the carbons is effected by a hollow armature affixed to the core of an electro-magnet, though the upper carbon holder is free to slide. When the current passes through the electro-magnet the armature and core are attracted, the armature is caused to tilt to one side and grip the carbon holder, and the core is attracted upwards. When the arc becomes too long less current passes, the armature releases its grip, and the carbon gradually drops till matters are equalised again.

3548. Apparatus for Extinguishing Fire, *A. M. Clark, London.—26th July*, 1882.—(*A communication from P. C. E. Taboüet, Paris.*) 10*d.*
The apparatus is constructed so as to be charged or put under pressure only at the time of use.

3557. Telephonic Apparatus, *J. Munro, West Croydon, and B. Warwick, Highbury Hill.—27th July*, 1882. 6*d.*
This relates to improvements in telephonic apparatus by which light metal conductors in delicate contact are made to transmit and receive speech by combination with sound chambers, &c.

3570. Electric Arc Lamps, *F. M. Newton, Barton Grange, near Taunton.—27th July*, 1882. 6*d.*
This relates to apparatus for regulating the speed of descent of the upper carbon in arc lamps. It consists of a cylinder partly filled with mercury and mounted on a horizontal axis which can turn freely with it. The cylinder is divided into a number of compartments by radial partitions, each compartment communicating with the next by one or more small holes. The cylinder may be attached to the upper carbon-holder in such a way that when the holder is released by the usual clamp or gripping piece, it must rotate the cylinder in falling. The latter offers little or no resistance to the motion at first, but as the centre of gravity of the mercury is moved, this resistance increases rapidly and checks the motion of the carbon.

3576. Distributing and Measuring Electricity, *Dr. J. Hopkinson, F.R.S., London.—27th July*, 1882. 6*d.*
This relates to a method of and apparatus for keeping the difference of potential constant in an electric lighting circuit; also to a means for combining a comparatively high potential in the main conductors of a circuit with a low potential in the houses supplied, three conductors being used and their sizes considerably reduced. Also to improvements in the inventor's electric meter.

3589. Machinery for Use in the Manufacture of Casks, *S. Wright, Egremont.—28th July*, 1882. 10*d.*
This relates to the employment of a collapsible core barrel constructed in segments and made considerably shorter than the length of staves to be placed thereon.

3591. Electric Producer and Power Machines, *J. Imray, Chancery-lane.—28th July*, 1882. 6*d.*
This relates to improvements with the object of simplifying the coiling of the wire in dynamos and utilising as much as possible the wire. The inventor claims the construction of an electro-magnet consisting of two iron shells or flanges, coiled with insulated wire in convolutions, and having alternating polar extensions projecting from their ends.

3624. Sleeping Berths for Ships, &c., *E. Lawson, Birmingham, and E. W. de Rusett, Anerley.—31st July*, 1882. 1*s.*
This refers to sleeping berths which can be made to fold up so as to economise space when not in use.

3631. Manufacture of Amber Varnish, *W. Morgan-Brown, London.—31st July*, 1882.—(*A communication from B. Borowsky, Germany.*) 6*d.*
The invention consists substantially in highly diluting the molten amber for the purpose of allowing the impurities to settle in a comparatively short time; the separation may be done as well by filtering, and afterwards the diluting material—turpentine—is removed by a distilling process, the very heavy turpentine vapour being carried away by a strong draught of air.

3655. Electric Lamps, *O. G. Pritchard, Penge.—1st August*, 1882.—(*Not proceeded with.*) 2*d.*
This relates to improvements in lamps where the carbons are made to abut on a piece of marble or other refractory substance, which is then raised to incandescence; and the object is to prevent the wasting away of the carbons.

3667. Apparatus for Indicating the Position of Railway Switches, *H. J. Haddan, Kensington.—2nd August*, 1882.—(*A communication from G. Otte, Apeldoorn, Holland.*) 6*d.*
This relates to apparatus consisting of a contact box, in which the movements of the switch points are reproduced, and which is so constructed that a current can only pass through the box when the switch points on one side or another are not in contact with their counter rails. Also to an indicating apparatus in combination with the above, for giving audible and visible signals of the movement of the switch points and their position.

3681. Apparatus for Facilitating Telephonic Communication, *J. Cowan, Garston, Lancashire.—2nd August*, 1882. 4*d.*
This relates to the erection of boxes in the streets containing telephones which are in connection with a central exchange, so that a subscriber to the exchange can communicate with any other subscriber. Each subscriber is to be supplied with a key by which to open the box.

3685. Dynamo-electric Machines, *W. R. Lake, London.—2nd August*, 1882.—(*A communication from H. C. Sample and F. Rabl, Camden, New Jersey, U.S.*) 6*d.*
This relates to the construction of dynamos so as to obtain more powerful magnets than ordinarily, and also to regulate the amount of current generated to the requirements of any particular case. The chief points in the invention are the construction of field magnets having two or more hollow cores wound with insulated wire, and arranged one within the other, and the combination with the commutator of electro-magnets in the main circuit, so that any alteration in the resistance of the external circuit is communicated to these electro-magnets, which act on the commutator, and cause it to alter its position with regard to the brushes, so that more or less current is collected by them as the case may be.

3698. Micro-telephonic Apparatus, *J. H. Johnson, Lincoln's-inn-fields.—3rd August*, 1882.—(*A communication from Dr. A. D'Arsonval, Paris.*)—(*Not proceeded with.*) 2*d.*
This relates to improvements on the inventor's patent No. 2065, for the 2nd May, 1882, and describes modifications of the micro-telephonic apparatus therein described, rendering it of small dimensions and readily portable.

3701. Apparatus for Preventing Down Draught in Chimneys, &c., *C. E. Hanewald, London.—3rd August*, 1882.—(*A communication from F. Haszelmann, Munich.*) 6*d.*
The inventor claims the arranging or combining parts forming means or apparatus for preventing down draught in chimneys, and for facilitating the escape of smoke and the application thereof to the ventilation of apartments, carriages, lamps, or other enclosures.

3708. Removing Particles of Straw, &c., from Wool, *H. J. Haddan, Kensington.—4th August*, 1882.—(*A communication from G. Fernau and Co., Bruges.*) 6*d.*
The invention consists in removing vegetable impurities from woollen fibres by carbonisation at any suitable moment after their passage through the carding, drawing, or combing machine.

3710. Electric Lighting and Apparatus connected therewith, *T. Parker and P. B. Elwell, Wolverhampton.—4th August*, 1882. 6*d.*
This relates to incandescent lamps, secondary batteries, and dynamos. The chief feature of the first part is the construction of carbon filaments from the fibres of the greater Plantain or wagbread. The Second relates to the construction of plates for secondary batteries by preparation in a dilute mixed solution of sulphuric and nitric acids; and the Third part to a new method of winding armatures.

3713. Electric Arc Lamps, *F. G. Brewer, Chancery-lane.—4th August*, 1882.—(*A communication from the Société Anonyme des Ateliers de Construction Mécanique et d'Appareils Electriques, Paris.*) 8*d.*
This relates to arc lamps on the "Cance" system, in which the feed of the carbons is determined by a screw acting on regulator by means of a nut motor. The improvements consist of various alterations of mechanical detail.

3717. Axles for Rolling Stock, &c., *W. R. Lake, London.—4th August*, 1882.—(*A communication from D. Anderson, Australia.*) 6*d.*
This relates chiefly to certain improvements in railway and other rolling stock, whereby the gauge of the wheels may be adjusted; it also relates to apparatus or devices whereby such alteration or adjustment of the gauge is effected.

3718. Machines for Crushing and Grinding Ore, Grain, &c., *W. R. Lake, London.—4th August*, 1882.—(*A communication from R. McCully, U.S.*) 10*d.*
This relates, First, to the provision of a jaw or jaws adapted and designed to reciprocate longitudinally, such movable jaw or jaws moving upon friction rollers suitably arranged upon the frame of the machine; Secondly, to the provision of a jaw or jaws having a simultaneous longitudinal and transverse reciprocating movement; Thirdly, to the provision of means for imparting to the jaw or jaws a simultaneous longitudinal and transverse reciprocating motion.

3734. Conveying, Raising, Weighing, and Delivering Grain, &c., *L. E. Mansfield, New York.—5th August*, 1882. 6*d.*
The object is to afford means for conveying grain and other materials from the holds of ships and other places, and of weighing the same into sacks or other receptacles in the desired quantities, and of delivering the materials on to the quay or other place, or to other ships or vessels, either in the receptacles into which the materials had been placed or otherwise, as desired.

3743. Hay-rakes, *G. Perrott, jun., Cork.—5th August*, 1882.—(*Not proceeded with.*) 2*d.*
This consists in fixing the teeth to the centre barrel or axle, with slit or cut bushes or cones of either brass, wrought iron, steel, or other metal.

3751. Electrical Signalling Apparatus for Railway and other Purposes, *W. R. Lake, London.—5th August*, 1882.—(*A communication from G. W. and A. D. Blodgett, Boston, Mass., U.S.*) 1*s.*
This relates to improvements in electric signalling apparatus adapted to automatically operate a gong or other signalling device at any predetermined time during each successive hour of the day or night; also circuit-breaking device for giving preliminary warning signals, &c. The specification is accompanied by detailed illustrations, and contains twenty-six claims.

3754. Furnaces for Utilising the Waste Heat from Gasworks, *W. R. Lake, London.—5th August*, 1882.—(*A communication from C. P. de Bondini, Constantinople.*) 6*d.*
The inventor claims the means of utilising the waste heat from gas furnaces for heating industrial furnaces, baking ovens, drying stoves, or the like.

3758. Ventilation of Railway Carriages, *A. R. and J. W. Harding, Leeds.—7th August*, 1882. 6*d.*
This relates to the employment of a water tank, through which the air is caused to pass by the motion of the vehicle.

3759. Apparatus for Perforating Cheques, Bills, &c., *P. Jensen, London.—7th August*, 1882.—(*A communication from O. A. Ericsson, Sweden.*) 8*d.*
This relates to improvements in the general construction of apparatus.

3763. Telephones, *J. J. Barrier and F. T. de Lavernède, Paris.—8th August*, 1882. 6*d.*
The inventors have in their telephone made use of magneto currents produced by the backward and forward movements of a magnet in a bobbin with closed circuit. The magnet or magnets are suspended by threads, wires, or flexible blades inside a series of stationary coils, and in front of the diaphragm which is spoken to. The vibrations of the diaphragm cause oscillation of the magnets, which induce currents in the stationary coils. Other minor improvements are described and claimed.

3764. Railways, *J. Dickson, jun., Seaforth.—8th August*, 1882. 8*d.*
This relates, First, to an improved form of transverse sleeper; Secondly, to chair brackets; Thirdly, to joint connections; Fourthly, to crossings; Fifthly, to switches.

3770. Preparation of Lead for Use in the Cells of Secondary Batteries, *L. Epstein, High Holborn.—8th August*, 1882. 4*d.*
The invention is carried out by the addition of permanganate of potash to molten lead, the latter being stirred energetically until the whole has solidified in a crumb-like state.

3780. Rotary Engines, *A. Kissam, Pimlico.—9th August*, 1882. 6*d.*
The inventor claims in a pair of cylinders, one revolving on its axis, inside and in close contact with, but excentrically to, the other, and touching also at the opposite side the hinges of plate pistons revolving on a fixed stud, concentrically with the outer cylinder, the said pistons passing through the inner cylinder, in combination with the ports and valve or valves, to effect the expansive working of engine.

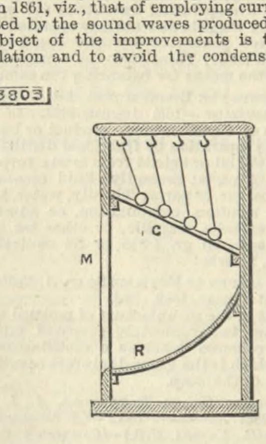
3793. Combined Door Mat and Scraper, *J. S. Willway, Bristol.—9th August*, 1882. 4*d.*
This consists in arranging a series of parallel flat or other shaped bars on edge tied at suitable distances apart by intermediate distancing pieces of tubular form or otherwise, and by transverse rods which bind the whole together.

3798. Poles and Stakes for Vines, Hops, &c., *W. A. Barlow, London.—9th August*, 1882.—(*A communication from F. Borner, Cologne.*) 6*d.*
This relates to improvements in metal poles for the support of vines, &c.

3802. Secondary Batteries, *C. T. Kingzett, Tottenham.—9th August*, 1882. 4*d.*
The inventor uses red lead at the electrode where the oxygen is given off during charging, and oxide of lead at the other electrode. He also charges his batteries in one direction only from the start, so that peroxide of lead is exclusively produced at one electrode, and reduced metallic lead at the other electrode. Other improvements are described.

3803. Telephonic Apparatus, *S. P. Thompson, Bristol.—9th August*, 1882. 6*d.*
This relates to improvements in telephonic transmitters based upon the principle discovered by Philip Reis in 1861, viz., that of employing current regulators actuated by the sound waves produced by the voice. The object of the improvements is to obtain loud articulation and to avoid the condensation of moisture on contact points if the instrument be spoken into at very close quarters. One method of carrying the invention out is shown in the accompanying figures, where M is the mouthpiece, C the current regulator, and R the reverberator, serving to collect the sound waves and direct them on to the current regulator, while intercepting moisture from the speaker's breath.

3803



3804. Timepieces, *W. Morgan-Brown, London.—10th August*, 1882.—(*A communication from J. J. D. Trenor, New York.*) 6*d.*
The object is to provide timepieces with means whereby the ordinary hands thereof, without being moved independently of the motion imparted to them by the ordinary time movement, may indicate the time at any two localities at once.

3805. Hardening and Tempering Steel Wire, *S., M., and A. Wood, Brighouse.—10th August*, 1882. 6*d.*
The object is to harden and temper steel wire for card making purposes, which is accomplished by passing wire through the flame of a furnace, by which the wire is softened previous to hardening and tempering.

3810. Looms and Dobbies for Weaving, *J. Shorrock, Darwen.—10th August*, 1882. 8*d.*
This relates, First, to the construction of the taking-up motion catch in looms for weaving; Secondly, to a fast and loose reed motion, which is for the purpose of enabling a heavy cloth to be made loose in a loose reed loom. Other improvements are described.

3812. Secondary Batteries, *J. S. Beeman, W. Taylor, and F. King, Cannon-street.—10th August*, 1882. 6*d.*
The inventors claim the formation of secondary batteries of ribbons or tapes of insulating material covered with metal combined with lead or lead salts, or of ribbons or tapes of metal in combination with an insulating ribbon or tape, alone or used to form a carrier for lead or lead salts. Also the use of powdered and inert material for covering the insulating ribbons, and other improvements in the mode of connecting the plates, &c.

3806. Vacuum and Steam Brake Apparatus, *S. Carlton, Swindon.—10th August*, 1882. 6*d.*
In the drawing A represents the train pipe; B a passage making communication with the train pipe A and check valve chamber C; a^1 is the check or non-return valve, with its cross-bar and is secured in position by the cover E; F is a mixing cone and G the discharging cone of the ejector; H is the steam cone protruding into the air space of the ejector; K is the valve box or chamber with the slide or distributing valve; L is the inlet for steam from the boiler to the valve chamber K. The outlet for steam to the steam brake cylinder from the port or passage e^1 communicates with the valve box K. f^1 is a port communicating with the steam cone of the ejector. Steam is admitted to the ejector and steam brake cylinder by means of the slide or distributing valve d^1, fitted with the exhaust port or cavity g^1, by way of which port the exhaust steam from the steam brake passes away to the ejector and thence to the chimney of the engine. N is the air inlet valve to train pipe with its chamber O^1.

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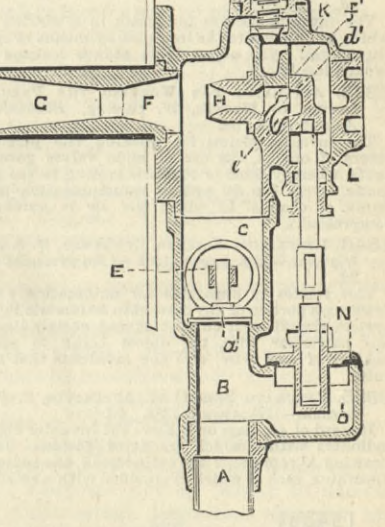


3816. Stoves or Furnaces, *H. J. Haddan, Kensington.—10th August*, 1882.—(*A communication from D. McB. Graham, Mass., U.S.*) 6*d.*
This relates to the combination of a stove and a drum arranged within it, and provided with flue pipes and air educts with two hot air induction pipes having dampers.

3820. Magneto-electrical Apparatus for Signalling on Railways, *J. H. Johnson, Lincoln's-inn-fields.—10th August*, 1882.—(*A communication from T. and J. Ducousso and the Société Anonyme Maison Brégnet, Paris.*) 6*d.*
This relates to an apparatus consisting of a combination of electro-magnets, which are placed in proximity to a rail. The passage of the wheels of the train induces currents in the magnets which are caused to act on another magnet at a distance, and which is connected by wires to the first-named magnets; the magnet so acted on can be made to give a signal.

3824. Meters or Registering Apparatus for the Electric Light, *A. M. Clark, Chancery-lane.—10th August*, 1882.—(*A communication from L. Houss-Humbert and J. de Brancion de Liman, Besançon, France.*) 10*d.*
This relates to a chronometric register which is set in motion immediately a lamp (or system of lamps) is lighted, and stopped when the current is cut off; the register therefore measures the time during which the lamp or lamps have been burning, and as the consumption of electricity is directly as the time of burning, the register indirectly measures the consumption of electricity. The inventors describe the apparatus used by them in detail.

3821. Electric Lamps, *F. Mori, Leeds.—10th August*, 1882. 4*d.*
This relates to an automatic switch for transferring the current from one pair of carbons, when these are consumed, to another pair in an arc lamp.

3822. Batteries for the Storage of Electricity, *F. Mori, Leeds.—10th August*, 1882. 2*d.*
This relates to batteries composed of sponge or honey-combed lead plates wrapped in lead foil, the surfaces being also coated with binoxide of manganese or acetate of lead. Asbestos packing is employed to insulate the plates.

3825. Electric Motors, *S. H. Emmens, Argyle-street.—10th August*, 1882.—(*Not proceeded with.*) 2*d.*
This relates to improvements in solenoids employed as electric motors. The inventor constructs a solenoid so that any portion of it can be brought into operation at will.

3829. Ventilating Sewers, &c., *T. S. Watson and H. F. Johnson, Manchester.—11th August*, 1882. 6*d.*
Artificial draughts are created by burning mixtures of carburetted hydrogen or other combustible gases and air.

3833. Machinery for Combing Fibres, *G. Little, Oldham, T. C. Eastwood, Bradford, J. Green and J. Fletcher, Oldham.—11th August*, 1882. 10*d.*
This consists, First, of mechanism for carrying and operating the feeding head; Secondly, means of operating the reciprocating nipping jaws; Thirdly, of mechanism for operating the divider or instrument employed for separating the fibre between the feeding head and the nipping jaws; Fourthly, of the application of and means for operating apparatus employed for preventing the waste of short fibre, and for condensing the sliver as and when drawn off the circle.

3834. Apparatus for Regulating Electric Light, *H. Wilde, Manchester.—11th August*, 1882.—(*Not proceeded with.*) 2*d.*
This relates to a novel method of regulating the carbons of an arc lamp.

3835. Alum and other Salts of Alumina, *P. and F. M. Spence, Manchester.—11th August*, 1882. 4*d.*
The invention consists in producing alum and other salts of alumina with but a very minute proportion of iron and of coloured organic impurity, by digesting their solutions with an oxide of manganese.

3836. Apparatus for Cutting Cloth, Leather, Rubber, &c., *E. Dredge, Hoxton.—11th August*, 1882. 6*d.*
This relates to machines in which an endless band knife or saw runs over pulleys and passes through a table on which the material to be cut is manipulated.

3837. Brooms, Brushes, &c., *A. J. Boult, London.—11th August*, 1882.—(*A communication from J. Gontier, Grenoble.*) 6*d.*
This relates to the manner of fastening the bundles of bristles, &c.

3838. Transporting Loads on Inclined Roads, *A. J. Boult, London.—11th August*, 1882.—(*A communication from F. Bouquet, Ile de la Réunion.*) 6*d.*
This consists of, First, iron rails which are suspended and connected with one another: Secondly, hooks or carriages mounted on rollers or wheels, and provided with movable brakes; Thirdly, a brake made of steel bands, fitted with shoes, and acting by means of a set screw.

3840. Neckties or Scarves, *D. T. Keymer and F. Theak, London.—11th August*, 1882. 6*d.*
This relates to the combination with the body and band of a necktie or scarf of a fastener, in such a

manner that the tie can be put on or taken off without withdrawing the end or ends of the band from the fastener.

3841. ARMPIT DRESS SHIELDS, *W. R. Lake, London.—11th August, 1882.—(A communication from J. A. Cansfield, Middlestown, Con.)* 6d.
This consists in the combination, with dies, of a heater box (with or without rounded projections or cheeks) and a heat guard or protecting casing.

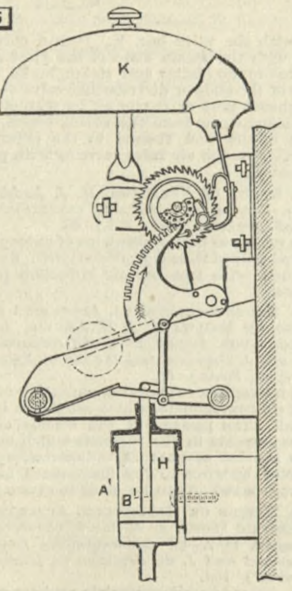
3842. SUSPENDING TELEGRAPH WIRES FROM IRON POSTS, *H. C. Jobson, Dudley.—11th August, 1882.* 4d.
The inventor secures insulators in a wooden arm, which he attaches to the iron post by means of special clip pieces. The object is to reduce leakage from broken insulators.

3843. APPARATUS FOR WORKING THE PNEUMATIC LEVERS OF ORGANS, *W. Carling, Hitchin.—12th August,* 1882. 6d.
The inventor claims for working the pneumatic levers of organs, the use of slide valves governing ports, whereby tubes or channels leading to the pneumatic levers can be put in communication with a trunk or channel in which the air is rarefied or compressed.

3846. REGULATING ELECTRIC CURRENTS, *W. S. Smith, Highgate.—12th August, 1882.—(Not proceeded with.)* 2d.
This relates to apparatus for automatically withdrawing a portion of any current in an electric lighting system should such current exceed certain limits in any particular wire, the object being to prevent heating of said wire, and the accidents that might ensue.

3855. PNEUMATIC SIGNALLING APPARATUS, *G. Porter, London.—12th August, 1882.* 6d.
Instead of air bags or bellows the inventor employs cylinders within which are fitted pistons. In the drawing A¹ represents the cylinders of the indicating apparatus, each of which is provided with a small pipe

3855



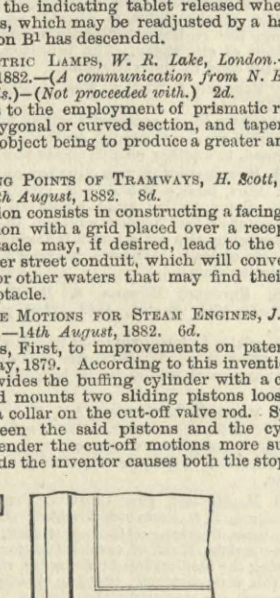
for connecting it with a transmitting device. By means of the piston B¹, piston-rod H, the system of levers shown, and the toothed gearing, the bell K is sounded, and the indicating tablet released when the piston ascends, which may be readjusted by a handle, after the piston B¹ has descended.

3856. ELECTRIC LAMPS, *W. R. Lake, London.—12th August, 1882.—(A communication from N. E. Reynier, Paris.)—(Not proceeded with.)* 2d.
This relates to the employment of prismatic rods of carbon of polygonal or curved section, and tapered at one end, the object being to produce a greater amount of light.

3859. FACING POINTS OF TRAMWAYS, *H. Scott, Liverpool.—12th August, 1882.* 8d.
The invention consists in constructing a facing point in combination with a grid placed over a receptacle, which receptacle may, if desired, lead to the street sewer, or other street conduit, which will convey the rain, storm, or other waters that may find their way into the receptacle.

3866. VALVE MOTIONS FOR STEAM ENGINES, *J. Edge, Liverpool.—14th August, 1882.* 6d.
This relates, First, to improvements on patent No. 2038, 22nd May, 1879. According to this invention the inventor provides the buffing cylinder with a central stop ring, and mounts two sliding pistons loosely on each side of a collar on the cut-off valve rod. Springs extend between the said pistons and the cylinder covers. To render the cut-off motions more suitable for high speeds the inventor causes both the stops and

3866



trip levers or the catch or catches to move in the same direction but at different speeds, so that one overtakes the other and the stop piece by means of a spring slide with the cut-off valve spindle. According to a second part of the invention stops are employed, which are controlled by the governor to shift a sliding block or link end in a slotted lever, by checking the movements of a vibrating part or of vibrating parts with which such block or link end is connected. The said sliding block may be connected by means of a link with the valve rod or with a cut-off arrangement.

3867. IRONING MACHINES, *H. Podger, Bromley, and W. H. Davey, Highgate.—14th August, 1882.* 6d.
This consists mainly in the combination with a vertically adjustable movable table of a longitudinally-reciprocating iron. It also consists in a gas or steam-heated iron, which is double faced and reversible, so that one face is being heated whilst the other is being used.

3869. DYNAMO-ELECTRIC MOTOR MACHINE, *E. Desfossés, Paris.—14th August, 1882.* 4d.
The inventor claims the use of magnetic pinions formed of bobbins, the number of which may be varied in proportion to the power required, and also the separation of the inductors by a dividing piece, so as to have two sets of inducing magnets.

3871. STARTING ENGINES, *A. B. Brown, Edinburgh.—14th August, 1882.* 6d.
This relates to the combination of parts forming a starting engine, in which a steam cylinder with a hydraulic locking cylinder having the same piston rod, which is jointed to the starting lever, has its attachment to the fixed framing in the form of a hinge joint or equivalent connection.

3873. APPARATUS FOR PRINTING OR LETTERING INDEXES, *W. R. Fordham, London.—14th August, 1882.—(Not proceeded with.)* 2d.
This relates to the construction of an apparatus whereby indexes may be printed or lettered in one or more colours at one operation.

3874. MACHINERY FOR BENDING, FLANGING, AND SHAPING METAL, *C. Scriven, Leeds.—14th August, 1882.* 6d.
In this machine the holding or gripping beam and the roller or rollers are operated by fluid pressure in suitable cylinders and the apparatus is provided with a system of distribution valves, so that the different parts can be put into separate or combined action as desired.

3876. APPARATUS FOR CLEARING TRAMWAY RAILS OF DIRT, *S. Shields, Liverpool.—11th August, 1882.* 6d.
This relates to a revolving brush formed of steel springs or other strong stout or suitable material caused to revolve upon each rail and shaped to suit the contour of the rail. The component parts of the brushes are so set as to sweep the dirt into the centre of the track between the horses' feet.

3878. CONSTRUCTION OF WHEELS FOR WAGONS, &c., *H. J. Barrett, Kingston-upon-Hull.—14th August, 1882.* 6d.
This relates to constructing metal wheels of readily detachable and renewable parts, whereby great strength and elasticity are combined with comparatively little weight, and a "dished" wheel, affording a widely extended bearing for wagons and other vehicles, is obtained.

3880. MANUFACTURE OF LEATHER, *J. H. Johnson, London.—15th August, 1882.—(A communication from A. G. Fell, New York.)* 6d.
This relates to the manufacture of leather by the method of forming a homogeneous mixture of fibre and gelatine.

3887. MANUFACTURING AXLES, AXLE-BOXES, &c., *J. Mackay, Liverpool.—15th August, 1882.* 6d.
This relates to improvements on patent No. 1147, A.D. 1882. The object is to manufacture the axles, &c., by stamping and forging them with dies and tools designed to meet the forms and configurations of the different parts.

3899. CUTTING MACHINERY FOR FORMING THE TEETH OF TOOTHED WHEELS, *W. R. Lake, London.—15th August, 1882.—(A communication from C. B. Albro, Philadelphia.)* 6d.
This consists partly in forming the cutter with a curvilinear surface parallel with its length, the said curve corresponding to the periphery of the wheel to be cut at the base or roots of the teeth, or in other words, the pitch line of the worm-shaped cutter being curved to correspond with the pitch line of the worm wheel to be cut, the cutting edges in the said cutter being arranged in a helix, and having their outer edges brought toward each other, so as to be in line with the radii of the worm wheel it is designed to cut; and it further consists partly in extending the cutting edges so as to make a complete worm with deep notches across the teeth.

3914. STEAM ENGINES, *P. Armington, Lawrence, Mass.—16th August, 1882.—(Complete.)* 6d.
This relates, First, to the peculiar construction of the valve regulating the supply of steam to the cylinder; Secondly, to the construction of the governor by which the valve-operating excentrics are operated upon directly by weights and springs operated by the centrifugal force generated by the speed of the revolving crank shaft; Thirdly, to the construction of the crank and the means for balancing the same.

3917. COMPOUNDS FOR DISINFECTING, &c., *C. Lowe and J. Gill, Manchester.—16th August, 1882.* 4d.
This consists of, First, residual product or heavy oil obtained by the separation by fractional distillation of the light essential oil or spirits from crude turpentine or pine oils, 25 parts; Secondly, fluid creosotes or heavy oils of coal tar, 35 parts; Thirdly, water, 3 parts, containing in solution, combination, or admixture, soap 5 parts, carbolic, cresylic, or other tar acid 15 parts, caustic soda, sp. gr. 1·345, or its equivalent of caustic potash, 2 parts.

3994. MANUFACTURE OF MOTTLED SOAP, *A. Heilley, Gosforth.—21st August, 1882.* 2d.
This consists in the manufacture of mottled soap by mixing together two separately prepared mixtures, the one being coloured so as to act as a mottling mixture to the other, which is the ground mixture constituting the chief body of the soap.

5655. PNEUMATIC GRAIN ELEVATORS, *A. J. Boult, London.—28th November, 1882.—(A communication from L. Smith, Kansas, U.S.)—(Complete)* 6d.
This consists in the arrangement of the grain tubes, which are provided with automatic valves and a vacuum chamber interposed between the mouth of the delivery pipe and the exhaust pipe, and it further consists in means for relieving the grain tubes of the vacuum pressure, for facilitating the delivery of the grain and taking it out of the current, and also in means for shutting off the admission of atmospheric air through the discharge grain tube. The suction feed pipe is so formed that the grain is fed through apertures, and the atmospheric air is brought in contact with the grain beneath it, so that the air power is utilised in connection with the blower to lift the grain. A dust trapping device between the vacuum chamber and the blower prevents the dust passing through the latter. A flexible hose combined with the feed and delivery conduits enables the latter to be swivelled to suit the feeding and delivery vessel.

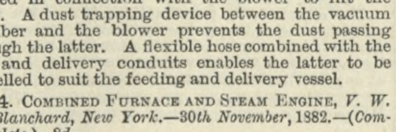
5694. COMBINED FURNACE AND STEAM ENGINE, *F. W. Blanchard, New York.—30th November, 1882.—(Complete)* 8d.
This relates partly to hydrocarbon furnaces and an apparatus for the production of steam, and for other purposes. Several improvements are described.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

272,940. GEAR WHEEL, *Bror F. Bergh, New York, N.Y.—Filed November 22nd, 1882.*
Claim.—(1) The combination, with the two parts of a divided gear or worm wheel, of a wedge piece pro-

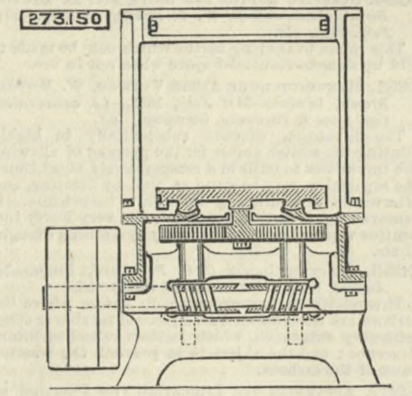
272.940



vided with a guide and resistance pin arranged within the side surface of the wheel, and a screw also arranged within the side surface of the wheel, fitting in one part of the wheel and adapted to draw the wedge piece against an inclined surface on the other part of the wheel, whereby the angular position of the parts of the teeth on the two parts of the wheel may be positively regulated in relation to one another, substantially as set forth.

273,150. DRIVING DEVICE FOR METAL PLANERS, *Lewis T. Pyott, Philadelphia, Pa.—Filed November 9th, 1882.*
Brief.—The table of the planing machine is given a traversing motion by means of two horizontal racks

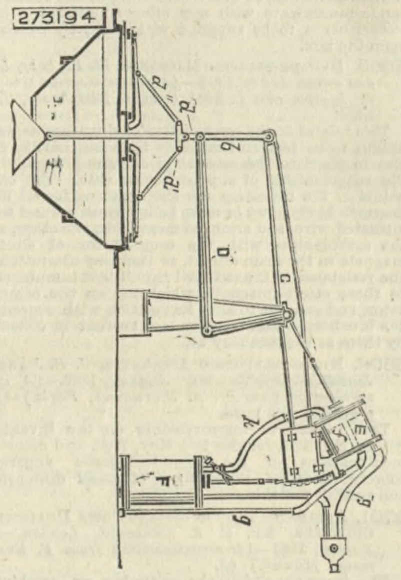
273150



gearing with pinion wheels on vertical shafts bearing worm wheels gearing with right and left worms on the driving shaft.

273,194. GAS SEAL FOR BLAST FURNACES, *Edward A. Uehling, Sharpsville, Pa.—Filed July 3rd, 1882.*
Claim.—(1) The combination, in a feed device and gas seal, with the mechanism for raising and lowering the lids and bell, of two engine cylinders E F, provided with a piston and rod, and connected, as described, by a pipe for the passage of the exhaust steam from one cylinder to the other, and connected at one end by a steam or air supply, whereby the bell and lids may be operated at different times, but in quick succession, as described. (2) The combination, with the mechanism for raising and lowering the bell and lids of a furnace hopper, of the cylinder C, having

273194



a piston and a rod with pin, the cylinder F, having a piston and a hollow rod with side aperture *f*, the steam supply pipes, the pipe *g g*, and the pipe *k*, the latter being provided with a valve forked at one end and weighted at the other, as and for the purpose specified. (3) In a feeding device for furnaces, the combination, with the hopper lids and the bell and rod for supporting the same, of the jointed rods d^{11}, the crosshead d^1, the sleeve *d*, the elbow lever D, pivotted at its elbow, the lever C, and suitable means for actuating said levers, as and for the purpose specified.

273,270. PRIMER FOR BLASTING CARTRIDGES, *Arthur Frothingham, Scranton, Pa.—Filed April 10th, 1882.*
Claim.—In combination with a blasting cartridge and with a fulminate cap to fire the same, a cap holder, constructed with a hole at the inner end to receive and

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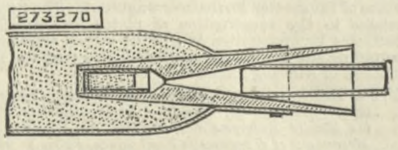

hold the cap, an opening through the holder, enlarged at the other end, to receive the fuse tube or needle, and with a connected intermediate opening, substantially as set forth.

273,336. ELECTRIC ARC LAMP, *George D. Allen, Brooklyn, N.Y.—Filed December 5th, 1881.*
Claim.—(1) In an electric arc lamp, a conducting pillar, rod, or support for a carbon carrier or holder in direct mechanical and electrical connection with said holder, and coated with porcelain or such like material formed by fusion into a vitreous or semi-vitreous

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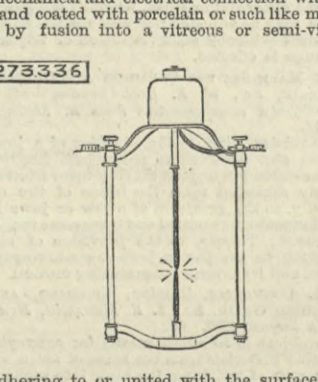

mass adhering to or united with the surface of the pillar, rod, or support, as and for the purpose described. (2) A frame for an electric arc lamp, the side bar or rods of which are in direct electrical connection with the carbon, and are coated with porcelain applied thereto in the manner and for the purposes set forth.

273,486. INCANDESCING ELECTRIC LAMP, *Thomas A. Edison, Menlo Park, N.J.—Filed October 20th, 1882.*
Claim.—(1) The method of preventing electrical carrying in incandescing electric lamps, consisting in raising the globe to the same or nearly the same potential as the filament, substantially as set forth. (2) In incandescing electric lamps, the combination, with the filament and the inclosing globe, of a neutralising conductor connected with the lamp circuit and located in contact with the lamp globe, substantially as set forth. (3) In incandescing electric lamps, the combination, with the lamp globe and the neutralising conductor external thereto, of the outer protecting globe, substantially as set forth. (4) In in-

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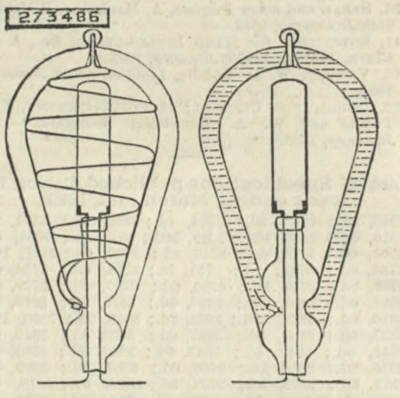

candescing electric lamps, the combination, with the lamp globe and the neutralising conductor of solid material external thereto, of the outer exhausted protecting globe, substantially as set forth.

273,379. DEVICE FOR PREVENTING HAMMER IN WATER PIPES, *Richard W. Miller, New Haven, Conn.—Filed July 18th, 1882.*
Claim.—The elliptical pipe A, provided with means for its attachment to a water pipe, and adapted by

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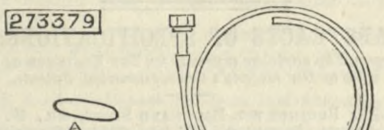

its form and thickness to spring and have its capacity enlarged by any sudden increase of water pressure within the same, substantially as and for the purpose specified.

273,652. INJECTOR, *Orson H. Wheeler, Charlesworth, Mich.—Filed November 21st, 1882.*
Claim.—(1) In an injector, the combination, with the body A, provided with the lifting tubes *e f*, the forcing tubes *h i*, and the water chamber *g*, of the removable cap *d* at the upper end of the body A, the nut D¹, carrying the forcing valve D, and the nut F¹, to which the outlet tube F and the overflow valve G are attached, arranged at the side of the body opposite to the forcing valve, substantially as herein shown and

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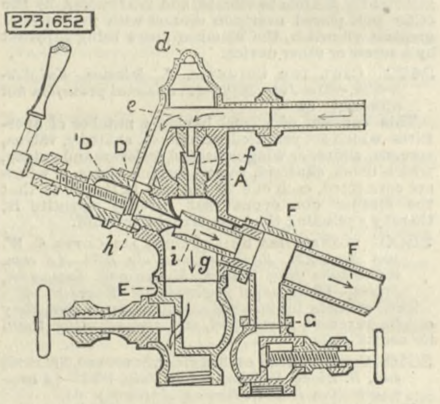

described, whereby provision is made for having access to the lifting tubes, forcing tubes, and water chamber, as set forth. (2) In an injector, the combination, with the body A, provided with the chamber *g*, and the waste valve E, of the lifting tubes *e f* and the forcing tubes *h i*, arranged as shown, the supply pipe F, and the overflow valve G, substantially as herein shown and described.

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