## THE GREAT ORGAN AT THE CRYSTAL PALACE.

THE Handel Festival Organ in the Crystal Palace is now being reconstructed and enlarged by its builders, Messrs. Gray and Davison, of Euston-road. It is almost certain that this Organ has been heard by more people than have heard any other musical instrument in the world. Those living in London and the suburbs who have not listened to its sounds must be few indeed. A large organ is so ingeniously constructed, that, regarded merely as a piece of mechanism, it has a special interest for engineers ; and we have no doubt that we shall please a great many of our readers by giving them particulars of the changes now being carried out by Messrs. Gray and Davison. But although organ music is familiar to most persons, few understand precisely how it is produced, and we propose here, in order that what we have to say concerning the Crystal Palace organ may be quite intelligible, to explain as simply and briefly as possible the general principles involved in the construction of all organs, which principles are modified according to the taste and skill of different makers and the purposes for which the organ is designed. This done, we shall give a sketch of the history of the Crystal Palace organ, and details of the alterations and improvements being effected in it.

An organ consists of an external case containing within it a large number of pipes, each of which is a separate wind instrument competent to produce but one note. In large organs there are several thousand pipes. Thus the Crystal Palace instrument will have 4394 pipes, and the organist can produce as many sounds. All these pipes may be classed under two heads, namely, (1) flue pipes, and (2) reed pipes. The flue pipe is neither more nor less than a whistle, the principle on which it acts and the details of its construction being practically the same as that of a dog whistle, or a "penny whistle.' The size of these whistles varies in the organ, the largest being a wooden pipe 2ft. square and 32ft. long, while the smallest is $\frac{3}{4}$in. long and $\frac{1}{4}$in. in diameter. The largest produces the deepest musical note which is audible, namely, C C C C. Its sound is an octave below the lowest C on the grand pianoforte. The reed pipe is so called because it has at its base a reed or vibrating tongue, which gives a peculiar character to the tone. Thus the clarionette and bassoon are reed instruments. The harmonium is indebted solely to reeds for its music. In the organ, reed pipes exist of various sizes, but they are seldom made more than 16ft. long, which gives a note in unison with the lowest C of the grand pianoforte.

Every one knows that organs are fitted with what are known as stops, and that these are named, as Diapason, Oboe, Voix Celeste, and so on. The sounds produced differ from each other not only in pitch, but in character or *timbre*. This difference is produced by modifications in the form of the pipes, especially at the mouth, and the character of the reed pipe is, of course, different from that of the flue pipe. So much premised, it will be understood that air under pressure must be provided, by admitting which to the pipes they are made to sound ; and the duty of the organist consists in admitting air to certain pipes and excluding it from others by the use of the keys or "manuals," and the pedals, which are really a second and larger set of keys, played on by the feet, just as the manuals are played on by the fingers, and by the "draw stops," which, as will be explained presently, control the various series of pipes. All large organs are sub-divided, that is to say, the outer case contains two or more separate organs, each of which can be played on distinctly from all the others, having its own special key-board. Thus the Crystal Palace organ has four separate sets of manuals and a set of pedals, and contains five distinct instruments, namely, the great organ, swell organ, choir organ, solo organ, and pedal organ. Arrangements are, moreover, made, which will be explained further on, by which any two or three of these can be "coupled'

FIG. 10

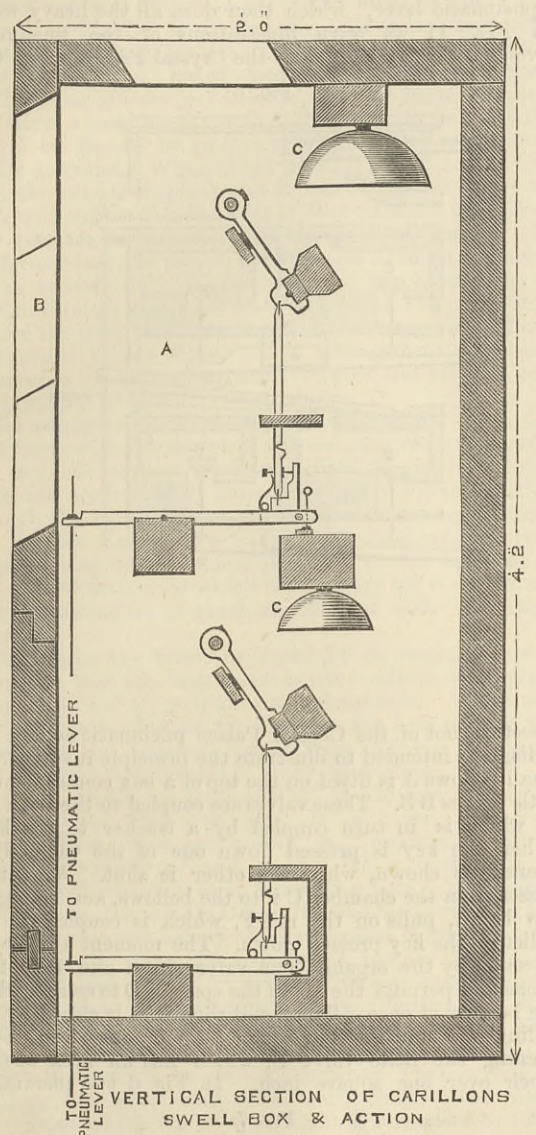



FIG. 9

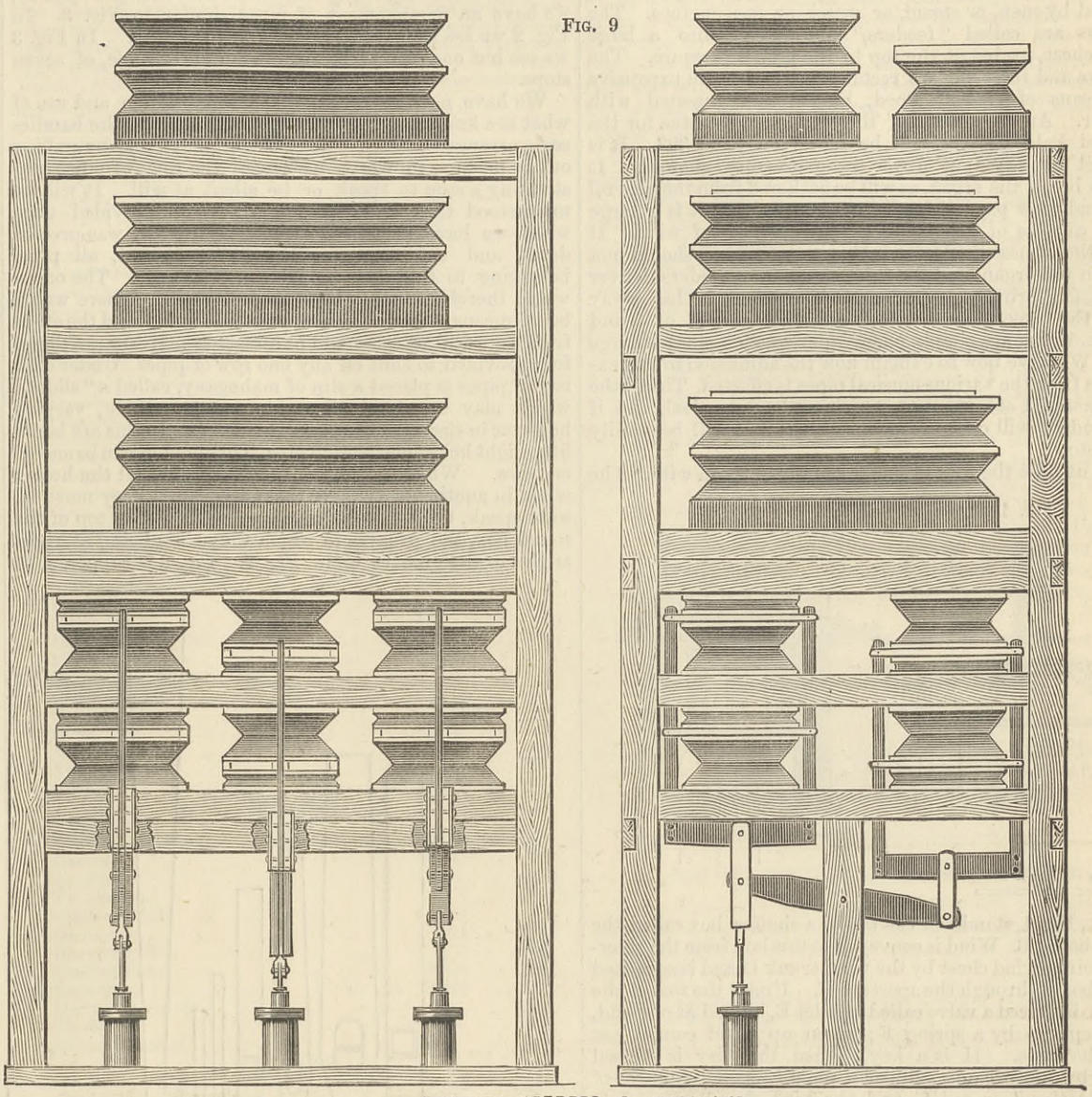
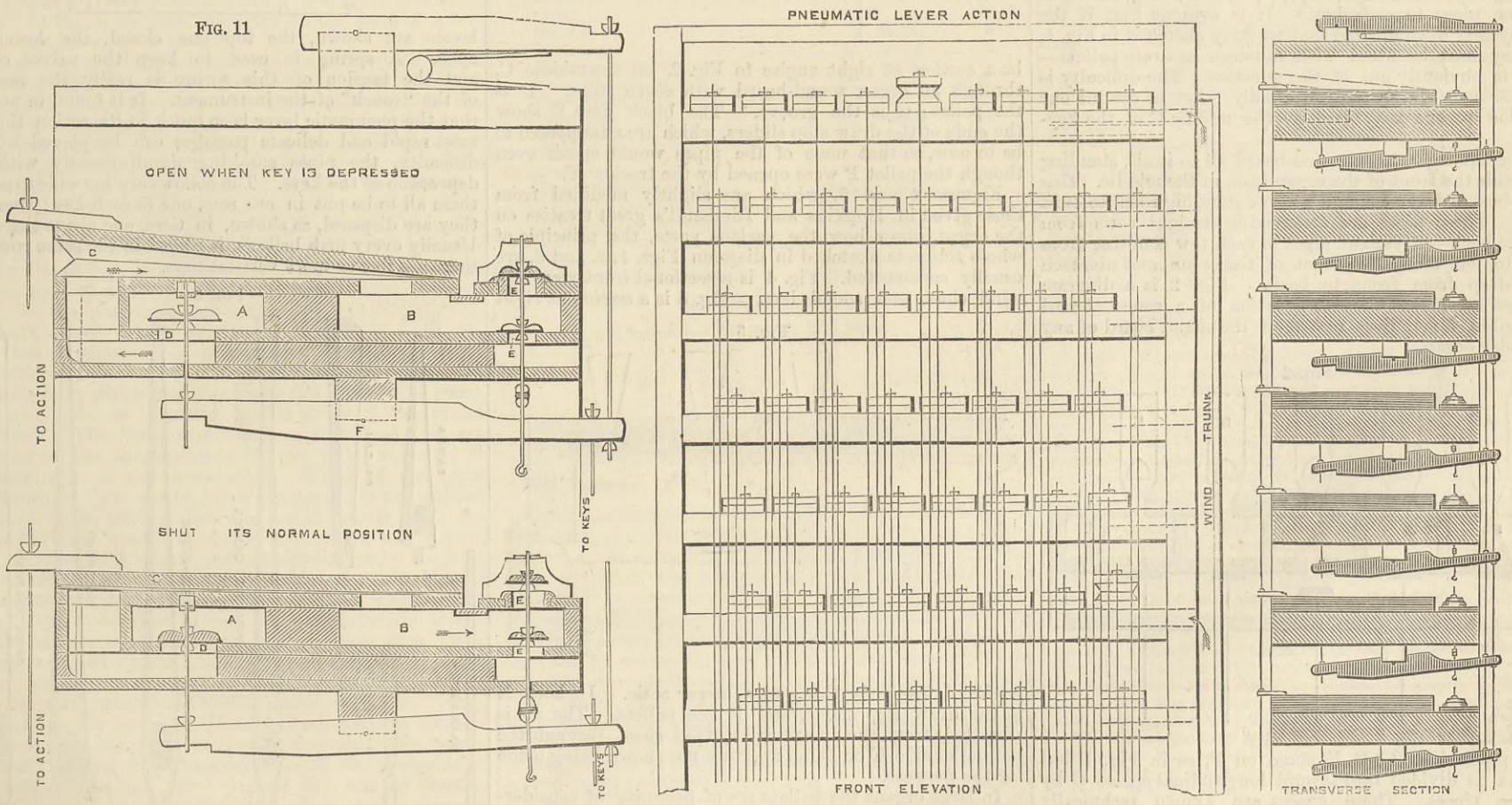



FIG. 11



together, so that practically the organist can perform on all five instruments at once if he wishes, or on one only.

Compressed air is always known technically by the organ builder as "wind," and its pressure is expressed in terms of inches of water which it will balance. The pressure varies in large instruments, some pipes requiring a greater pressure than others to make them "speak" properly. The normal pressure in an ordinary church organ is about 3in., and a stop is said to be "on a 3in. wind" or "a 4in. wind," and so on. The wind is obtained by the aid of large bellows, worked by men, or steam, or water or gas engines. The bellows are called "feeders," and deliver into a large wind chest, loaded at the top to the proper pressure. The bellows and reservoir are rectangular, and made expansive by means of ribs of wood, hinged and gusseted with leather. An illustration of the blowing apparatus for the Crystal Palace organ will be found on page 393. It is worked by three of Joy's water-pressure engines. It stands below the organ, as will be gathered from the general sectional view page 400. It will be seen that it is a large affair, capable of delivering a vast quantity of wind. It is of the utmost importance that the pressure should not vary in the organ, and for this reason four feeders deliver into each primary reservoir. The wind is led away from the reservoirs to the organ by means of wind trunks, which are simply rectangular wooden pipes of large size. We have now to explain how the admission to and exclusion from the various musical pipes is effected. This is the most complex subject with which we have to deal, and if our readers will once grasp this all the rest will be readily understood.

Let us take the case of one pipe only to begin with. The

Fig. 1

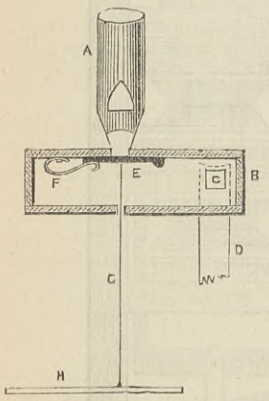
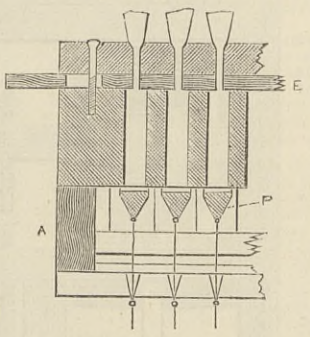



Fig. 4

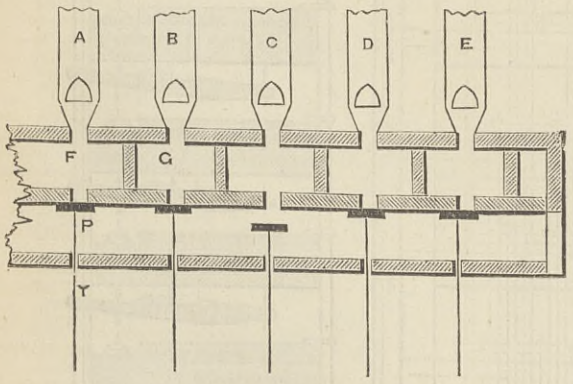



pipe A, Fig. 1, stands on the top of a shallow box called the sound board B. Wind is conveyed to this box from the reser-reservoir or wind chest by the wind trunk D, and is admitted to the box B through the aperture C. Under the foot of the pipe A is placed a valve called a pallet E, hinged at one end, and kept up by a spring F; when up wind cannot get into the pipe. H is a key; when this key is pressed down by the organist's finger it pulls E open by means of the "tracker" or rod G, and the pipe then "speaks" or sounds so long as H is kept down.

Now, we have said that in one organ case are included one or more organs. Each organ includes several stops. Thus in the Crystal Palace organ the great organ has nineteen, particulars of which will be found further on. The key-board or manual of the great organ has fifty-eight keys; but each one of these keys must be able to govern each one of the nineteen stops. Each stop is for each key represented by one pipe; that is to say, there are nineteen pipes to each key.* It is evident that if the same system were adopted that we have sketched in Fig. 1, each key must be fitted with nineteen separate pallets—which is obviously out of the question. The difficulty is got over very simply and effectually. Let us confine our attention to one key, namely, the middle C of the key-board.

The great organ has a sound-board all to itself, standing just inside the front of the organ case, in the middle. This sound-box is large enough to give standing room to 1624 pipes.† These pipes are arranged in straight rows from front to back—fifty-eight pipes in each row counting from right to left along the front of the organ, and nineteen pipes deep from front to back. Fig. 2 is a diagram intended to make the construction of a sound board intelligible, but it does not show the sound board of any particular organ.

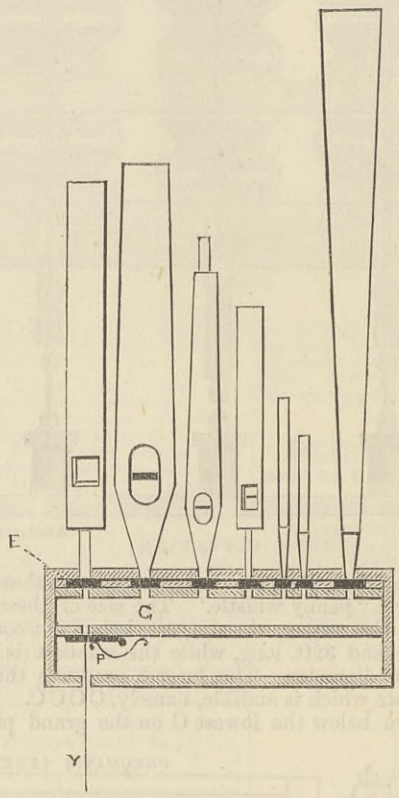
Fig. 2




The pipes A B C D E stand on F, as in Fig. 1, but the box is divided into several longitudinal spaces G by distance pieces. These spaces are known technically as "grooves." P are the pallets, which can be pulled down by the trackers Y. There is only one pallet to each groove, and the result is that when any key is pressed down wind is admitted to the corresponding groove, and thence to all the pipes standing on that groove. In the sketch the pallet for pipe C is pulled down, and all the pipes on the groove controlled by that pallet may be sounding. If we assume the key to be the middle C, then the open diapason, Claribel flute, double trumpet, oboe, &c., will sound each its own middle C.* In this way then it will be readily understood that a single pallet can control as many pipes as there are stops in a sound board. Looked at in a direction at right angles to that in which Fig. 2 appears, we have an arrangement of pipes similar to Fig. 3. In Fig. 2 we see the several pipes of but one stop. In Fig. 3 we see but one pipe each, say the middle C pipe, of seven stops.

We have now to consider the construction and use of what are known as the "draw stops," namely, the handles seen arranged at each side of the organist, and by pulling out or pushing in which he causes the rows of pipes constituting a stop to speak or be silent at will. It will be understood that if nothing more were provided than what we have sketched, as soon as the key was pressed down and the corresponding pallet opened, all pipes belonging to that key would speak at once. The organ would therefore always be at its full power. There would be no means of modulating intensity of sound, and the effect from a musical aspect would be disastrous. Means are therefore provided to shut off any one row of pipes. Under each row of pipes is placed a slip of mahogany, called a "slider," which may be about 3in. wide and $\frac{3}{8}$in. thick, varying however in size with the pipes it controls. In this are bored fifty-eight holes, one for each pipe. These sliders can be moved endwise. When in one position they shut all the holes; when in another they leave them all open. They move in, so to speak, the thickness of the sound board on top of the sound box, the grooves in which they slide being at right angles to the grooves G in Fig. 2. Fig. 3 is supposed to

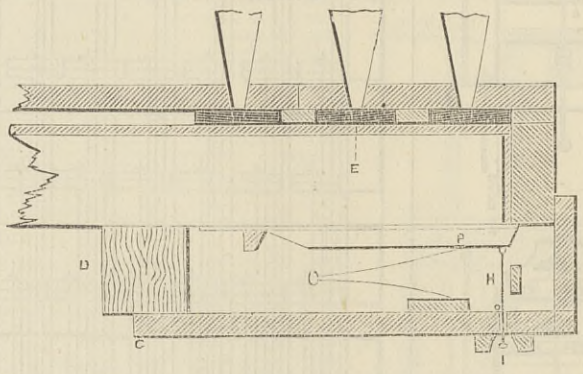
Fig. 3




be a section at right angles to Fig. 2, on the middle C, through an organ sound-board with seven stops. P is the pallet; G is the groove. The black lines E show the ends of the draw stop sliders, which are all supposed to be in now, so that none of the pipes would speak even though the pallet P were opened by the tracker Y.

Figures 4 and 5, which are slightly modified from those given in Hopkins and Rimbault's great treatise on the organ, show how the various parts, the principle of whose action is sketched in diagram Figs. 1, 2, and 3, are usually constructed. Fig. 4 is a sectional front view of a wind chest and sound box. Fig. 5 is a section at right

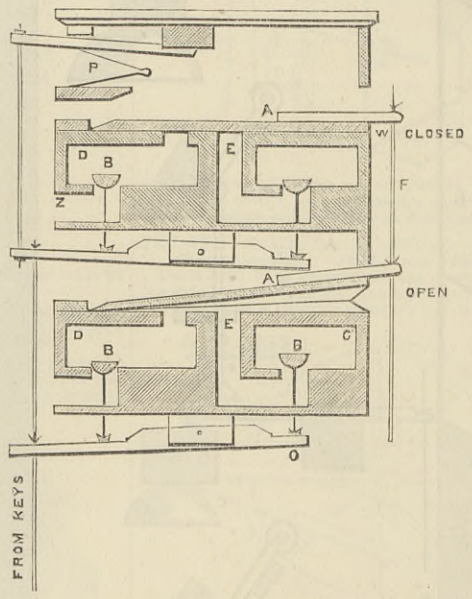
Fig. 5




angles of the same thing to a larger scale. In both E is the draw stop slider, and P the pallets. The air is admitted from the reservoir or wind chest through the bottom or side C or D, an aperture not shown being made for the purpose.

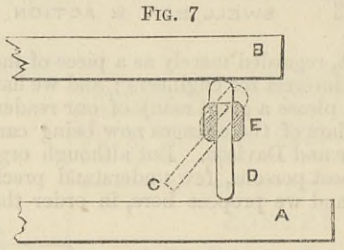
In large organs the pallets are of necessity of considerable size, because they have to admit air enough to supply each a great many large pipes. Their range of motion is also considerable. The area of a pallet may be as much as 30 square inches, and the pressure on it with a 14in. wind would be nearly $\frac{1}{2}$ lb. to the square inch; to open it would, therefore, require a pull of nearly 25 lb. But a good organ will speak when the key of a manual is depressed about $\frac{1}{8}$in. Consequently there must be a loss of leverage between the key and the pallet, and the result would be an intolerable strain on the fingers of the organist. In the modern instrument the touch is, however, nearly as light as that of a pianoforte, but in the old instruments it was almost impossible to play music requiring rapid execution, save by a very muscular musician, using only a limited number of stops. In large modern organs the organist when he presses down a key does not pull down the pallet in a groove, but a secondary and very small valve, which admits air to what is known as the "pneumatic lever," which then does all the heavy work. In Fig. 11 we give illustrations of the pneumatic levers of the great organ at the Crystal Palace. Fig. 6 is

Fig. 6



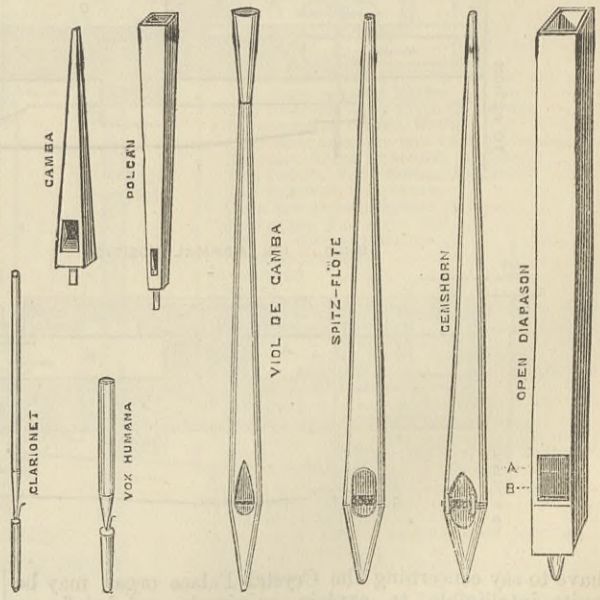

a section, not of the Crystal Palace pneumatic action, but a diagram intended to illustrate the principle involved. A small bellows A is fitted on the top of a box containing two little valves B B. These valves are coupled to the back fall O, which is in turn coupled by a tracker to the key. When the key is pressed down one of the valves B is opened as shown, while the other is shut. Wind now passes from the chamber C into the bellows, and lifting its top board, pulls on the rod F, which is coupled to the pallet of the key pressed down. The moment the key is released by the organist one valve closes and the other opens and permits the air in the space E D to escape, when the bellows at once collapse, and the pallet is closed by the falling of W and F. The work of the organist consists in opening the little valve B, which has an area of not much over one square inch. In Fig. 6 two pneumatic

Fig. 7




levers are shown, the top one closed, the lower one open. A spring is used to keep the valves closed, and the tension of this spring is really the measure of the "touch" of the instrument. It is found in practice that the pneumatic lever is so quick in its action that the most rapid and delicate passages can be played without difficulty, the pipes speaking simultaneously with the depression of the keys. The bellows are too wide to permit them all to be put in one row, one to each key; therefore they are disposed, as shown, in tiers, one above the other. Usually every fifth bellows is placed in the same row, and there are five or more vertical tiers.

Fig. 8




The pedal mechanism does not call for special description, pedals being nothing more than enlarged keys; but even to pedals the pneumatic action is now adapted, to lighten the work of the organist. The most important section remaining to be described is the coupling. We have said that any two or more of the organs can be

* There are really many more, but as the additional pipes go from three to five to a note, each set of these may for clearness be regarded as one pipe only.

† This is not strictly true, and there are really four sound boards to the "great organ." In the Crystal Palace organ some of the pipes are placed where there is room at a little distance, the wind being led to them by tubes. These pipes are said to be "conveyanced off."

* Only what are known as "foundation stops" will give this note, but to avoid confusion we keep for the moment all reference to the harmonic pipes from the body of this article.

coupled to each other; and this is usually done by coupling the keys. Thus, when the great and swell, for example, are coupled, the keys on the swell manual move when the great manual is played upon, the effect being the same as though there was one player to each organ. There are besides couplers by which one section of a keyboard is coupled to another. Thus, when the organist plays one set of notes with his fingers, all the same notes one octave above or below are played at the same time. The pedals, again, can be made to act on the great or other organ, and so on. The arrangements by which this apparently complex work is done are extremely simple. There are several devices in use; if we describe one it will suffice. In Fig. 7, A B are the inner ends of two keys, one, A, being, let us say, for the choir, and the other, B, for the great organ. E is a bar of wood running across the organ, in which bar are as many holes as there are keys. In each hole slides a hard wood peg C. The bar E can be partially turned on its axis by an iron treadle, worked by the foot of the organist. When in the position shown by the full lines, the pegs C couple A and B. It is impossible to play on A without moving the keys of B at the same time; but it is possible to play on B and not move the keys A. In the former case the pegs C work up and down in the holes in the cross-bar E. If, however, the bar E be made to revolve through about one-sixth of a circle, the pegs C will assume the position shown in the dotted line, and will not be touched by the keys. This arrangement has been superseded by mechanism more complex and efficient, but the principle involved is clearly shown.

The arrangement of the sound-boards within an organ case varies with the design of the case, the space available, &c.; and the various trackers radiate in different directions, and are led off in various ways. We give a section through the Palace organ, which illustrates our meaning. But all the devices for leading the trackers are very simple, being for the most part bell cranks in wood or iron. The distance to which trackers are led is sometimes very considerable, as much as 80ft. or 90ft. not being unknown.

Concerning the music produced by an organ, it is well to explain that the instrument is not a collection of pipes intended to imitate well-known instruments. There are, it is true, such pipes, as, for example, the trumpet and the flute; but the diapason has no true analogue in a band, and the same may be said of many other stops.

In a foot-note we have alluded to the fact that there may be more than one pipe in a given stop to a note. These pipes are known as "mixture," "furniture," "sesquialtera," and so on. Their purpose is to sound the harmonics to a foundation note. Thus, when we put down the middle C key, the diapason sounds C, but the other pipes we have just named sound harmonics to it. The harmonic pipes are arranged in rows or "ranks," as they are called. Thus, for instance, we may have one open diapason pipe, two principals, three twelfths, and four fifteenths, or, in all, ten pipes to a single diapason note. Again, in a "four-rank" stop we may have, from C C to middle B, tones 19—22—26—29, and so on. The introduction of these harmonics adds power and richness to the music, for reasons which will be understood in a moment by those who have studied even the elements of acoustics.

The varying character of the sounds produced by different stops is due to the shape and material of the pipes, and to some other influences which are not without interest. Thus the voix celeste, usually regarded as the most beautiful and plaintive stop known, owes its charm, curiously enough, to the fact that each note is produced by two pipes, which are first tuned accurately in unison, and then put out of tune by very slightly raising the pitch of one of them. In Fig. 8 we give examples of the form of a few pipes, each of which is named.

We give on page 400 a longitudinal section of the organ, as it would be seen if the front of the case with the key-boards were removed, as well as the seats in the orchestra. The organ stands on a stout platform or floor, 40ft. wide by about 25ft. deep, which is supported by timber framing, as shown, rising from the main floor of the Palace. At A will be seen the blowing apparatus, with the water-pressure engines beneath. These engines are extremely simple, and their construction is too well known to need description. They have been supplied by Mr. David Joy, of Anerley Park. At B are shown some of the rods of a few of the draw stops. Right in front, at C, is the pneumatic lever arrangement of the great organ D, above which is the solo organ E. At the very top is shown the swell organ F. All its pipes are enclosed in a box, the front of which is fitted with louvre boards, which can be opened and closed by a pedal, so as to modify or augment the loudness of the sound produced. The lines seen running right and left are trackers to the sound-boards of the pedal organ G G on each side of the instrument. Many of the pipes are shown in their places, but a large number are omitted to show those behind, but the sound-boards, with the holes in them ready to receive the pipes, are shown. The choir organ is behind, and entirely hidden by the great organ. H and H are gangways, by which access is obtained to various portions of the organ. T T are wind trunks. Fig. 11 gives sections of one set of pneumatic levers. All the rest are nearly identical, save in dimensions. Fig. 9 is an enlarged view of the blowing apparatus.

Our readers are now, we venture to hope, in a position to understand what the Crystal Palace organ is. When the first of the series of Handel Festivals was contemplated, it was felt that an organ of considerable power, especially in the deep bass department, was desirable, if not indeed essential. The original idea was to erect an instrument simply for "filling up" effects in the choruses, &c., the presence of the full orchestra rendering the more delicate organ effects unnecessary. Later on, however, it was thought that by adopting a more comprehensive scheme the organ might be utilised by the Crystal Palace Company as a solo instrument and for general purposes. Accordingly a specification was drawn up for a grand organ of four manuals and pedals, and eventually carried out. A portion of the instrument in this form—a large number of the stops not being inserted, but "prepared for" only—was finished, and used at the first rehearsal in 1857, and afterwards at the first Festival performance in 1859. The organ was further developed in the year 1871, when some of the "prepared for" stops were supplied. It was, however, still left incomplete, and so it has remained until now.

We subjoin the specification of the organ in its reconstructed form:—

## SPECIFICATION.

*Four manuals—overhanging—CC to A, 58 notes and pedals—concave, but not radiating—CCC to F 30 notes. Pneumatic action to each clavier. Twelve double French vertical feeders, supplying four bellows, communicating with the various inner wind reservoirs. Motive power—three of Joy's patent hydraulic engines.*

| | | | Ft. |
|---|---|---|---|
| **Great organ:—** | | | |
| Double open diapason | metal | ... | 16 |
| Large open diapason | ,, | ... | 8 |
| Open diapason | ,, | ... | 8 |
| Flute-à-pavillon | ,, | ... | 8 |
| Harmonic flute | ,, | ... | 8 |
| Claribel flute | wood | ... | 8 |
| Quint | metal | ... | 6 |
| Octave | ,, | ... | 4 |
| Flute octaviante | ,, | ... | 4 |
| Twelfth | ,, | ... | 3 |
| Super octave | ,, | ... | 2 |
| Harmonic piccolo | ,, | ... | 2 |
| Mixture, 4 ranks | ,, | | |
| Furniture, 3 ranks | ,, | ... | |
| Cymbal, 5 ranks | ,, | | |
| Double trumpet | ,, | ... | 16 |
| Posaune | ,, | ... | 8 |
| Harmonic trumpet | ,, | ... | 8 |
| Clarion | ,, | ... | 4 |
| **Swell organ:—** | | | |
| Bourdon | wood | ... | 16 |
| Open diapason | metal | ... | 8 |
| Keraulophon | ,, | ... | 8 |
| Concert flute | wood | ... | 8 |
| Octave | metal | ... | 4 |
| Flute octaviante | ,, | ... | 4 |
| Twelfth | ,, | ... | 3 |
| Super-octave | ,, | ... | 2 |
| Harmonic flageolet | ,, | ... | 2 |
| Mixture, 4 ranks | ,, | | |
| Furniture, 3 ranks | ,, | | |
| Contra-fagotto | ,, | ... | 16 |
| Cornopean | ,, | ... | 8 |
| Oboe | ,, | ... | 8 |
| Echo tromba | ,, | ... | 8 |
| Vox humana | ,, | ... | 8 |
| Clarion | ,, | ... | 4 |
| Tremulant. | | | |
| **Choir organ:—** | | | |
| Lieblich Bourdon | wood | ... | 16 |
| Gamba | metal | ... | 8 |
| Salcional | ,, | ... | 8 |
| Voix celeste | ,, | ... | 8 |
| Clarionet flute | wood | ... | 8 |
| Gemshorn | metal | ... | 4 |
| Harmonic flute | ,, | ... | 4 |
| Claribel flute | wood | ... | 4 |
| Spitz flute | metal | ... | 2 |
| Harmonic piccolo | ,, | ... | 2 |
| Clarionet | ,, | ... | 8 |
| Orchestral oboe | ,, | ... | 8 |
| Tremulant. | | | |
| **Solo organ:—** | | | |
| Grand open diapason | metal | ... | 8 |
| Flute harmonique | ,, | .. | 8 |
| Flute octaviante harmonique | ,, | ... | 4 |
| Corno di bassetto | ,, | ... | 8 |
| Grand tromba | ,, | ... | 8 |
| Carillons | | | |
| **Pedal organ:—** | | | |
| Double open diapason | wood | ... | 32 |
| Open diapason | ,, | ... | 16 |
| Open diapason | metal | ... | 16 |
| Violone | wood | ... | 16 |
| Bourdon | ,, | ... | 16 |
| Quint | ,, | ... | 12 |
| Octave | metal | ... | 8 |
| Violoncello | wood | ... | 8 |
| Mixture, 4 ranks | metal | ... | |
| Contra-bombarde | wood | ... | 32 |
| Contra-posaune | ,, | ... | 32 |
| Trombone | metal | ... | 16 |
| Ophicleide | wood | ... | 16 |
| Clarion | metal | ... | 8 |

**Couplers:—**

| | |
|---|---|
| Swell to great, unison. | Choir to great. |
| Swell to great, sub-octave. | Choir octave. |
| Swell to great, super-octave. | Solo to pedal. |
| Swell to choir. | Swell to pedal. |
| Solo to great. | Great to pedal. |
| Sforzando (great to swell). | Choir to pedal. |

## RECAPITULATION.

| | | | | |
|---|---|---|---|---|
| 19 | stops in the | great organ, | 1624 | pipes. |
| 17 | ,, | swell ,, | 1264 | ,, |
| 12 | ,, | choir ,, | 696 | ,, |
| 6 | ,, | solo ,, | 290 | ,, and 37 bells. |
| 14 | ,, | pedal ,, | 510 | ,, |
| 68 | sounding stops, | | 4394 | pipes. |
| 14 | mechanical stops, couplers, tremulants, &c. | | | |

Total, 82 stops.

The space occupied by the instrument is 40ft. wide by 24ft. deep, exclusive of that taken up by the five bellows behind, which have hitherto been ordinarily blown by ten men, supplying the various reservoirs inside the organ with wind at different pressures. It has now been decided to remodel the instrument and complete it in all respects, applying entirely new bellows and feeders adapted for blowing by water engines. The motive power will be supplied, as we have said, by three hydraulic engines, one of 6½in., one of 5½in., and one of 5½in., driven by water from the tower of the Palace at an estimated minimum pressure of 100 lb. to the square inch. The blowing apparatus is arranged under the orchestra so as to be seen at work by any visitors to the Crystal Palace who are curious enough to inspect it. Though in so enormous, and at the same time lightly constructed, a building, it will probably surprise some to learn that this organ, although more powerful, is not so large as several well-known instruments far more favourably situated in smaller and more substantial halls.

The wind pressures have been revised, and in some departments increased, but not to the extreme to which this has been carried in certain recent instances. It is nevertheless believed that the power will prove ample, without being "blatant" and oppressive from very din, as in some modern organs voiced on the so-called "German systems." It has also been an object to avoid the undue predominance of "Reeds" and reedy Gambas, which give some of our large modern organs on the French system so much the effect of gigantic harmoniums. At the same time every variety of tone is at command, whilst mere "vain repetitions" are avoided. One of the new features consists in the addition of three octaves of carillons or bells, enclosed in a swell box with Venetian louvres, so as to be capable of crescendo and diminuendo effects. The range is from gamut G upwards. The hammers are put in motion by the pneumatic key action of the solo organ. Fig. 10 is an end view. The bells are hung on horizontal bars and struck by hammers arranged like those of a piano but of course very much larger. The organ will be revoiced throughout.

Until now there were but two sets of pneumatic levers, one to the great organ and one to the swell for lightening the touch. There will hereafter be five—namely, one to each of the four manual claviers, and one to the pedal clavier. These will be of the most improved modern construction, with double exhaust. The wind pressures will range from 4in. to 12in., the foundation stops of the great and swell being on a 6in. wind, with the reeds raised to 8in. in the treble. The "tromba" in the solo organ will be on a 12in. pressure, and the rest of the solo organ 8in. Instead of the usual English system of composition pedals for drawing out and putting in groups of stops to produce different combinations, the continental "Ventil" system was adopted as on the whole best for such an instrument, balancing advantages and disadvantages, and has been retained. Under this arrangement the great organ sound-board is subdivided into four sections, each containing its own group of stops, and by means of four pedals either left up in their normal position or "hitched down," the wind is either cut off from or admitted to each department by the "ventil." The manual organs as well as the pedal organ are similarly treated.

It may be remarked, as a matter of comparison, that Messrs. Gray and Davison's celebrated organ in the Leeds Town Hall, erected in 1859, has 94 sounding stops and 17 couplers, &c. It is expected that the Crystal Palace organ will be re-opened early in the present summer. Mr. Alfred J. Eyre is the Crystal Palace organist, and his reputation is a sufficient guarantee that full justice will be done to Messrs. Gray and Davison's noble instrument.

## THE ELECTRIC LIGHT COMMITTEE.

THE following are the recommendations which the Select Committee on the Board of Trade and other electric lighting Bills have resolved to make to the House of Commons as the result of their inquiry:—

(1) "That the Board of Trade be empowered to grant licences to local authorities or private undertakers, with the consent of such local authorities, to supply electricity within a defined area."

(2) "That such licences be for any period not exceeding five years, but may at the expiration of the licence be renewable with such consent as aforesaid."

(3) "That the Board of Trade be empowered to grant provisional orders to local authorities, or to private undertakers without the consent of such local authorities, for the supply of electricity; but such provisional orders shall be subject to confirmation by Parliament."

(4) "That notice of any application for a licence or a provisional order be given by public advertisement in the district, and full opportunity be given to all parties interested to state their case to the Board of Trade."

(5) "That no application for a licence or provisional order be granted until the expiration of three months from the notice of such application."

(6) "That no application by any local authority for a provisional order under this Act be proceeded with until it has been submitted to a meeting of the local authority specially summoned for the purpose by a public notice."

(7) "The licences and provisional orders should carry with them power to break up the streets for the purpose of laying the necessary wires."

(8) "That where it has been proved to the satisfaction of the Board of Trade that any area as defined by licence or provisional order is sufficiently supplied with electric light, and that the supply of gas in such area has ceased to be remunerative, the Board of Trade may be empowered to make an order relieving either wholly or in part any corporation or gas authority from being compelled to supply gas within such area."

(9) "That local authorities be empowered to purchase compulsorily the undertaking of the company or person authorised by provisional order to supply electricity at the end of fifteen years, or at the end of any subsequent period of five years."

(10) "That for the purpose of the purchase of the undertaking, the value of the land, buildings, works, materials, and plant shall be deemed to be their fair market value at the time of the purchase, due regard being had to their nature and their condition, to their state of repair, to their suitability to the purposes of the undertaking; and where a part only of the undertaking is purchased, to any loss occasioned by severance; but without any addition in respect to compulsory purchase, or of goodwill, or of any past or future profits, or of any similar consideration."

(11) "That licence and provisional orders should contain such regulations:—(*a*) For securing the safety of the public from injury to life or from fire; (*b*) for inspection; (*c*) for securing a regular and efficient supply of electricity; (*d*) for fair prices as experience may prove to be necessary, and where it has been proved to the Board of Trade that public safety is likely to be endangered, they shall at all times have power to make such further regulations as may be required for securing the safety of the public."

(12) "That overhead wires be forbidden without the consent of the local authority, and where it has been proved to the satisfaction of two justices of the peace, or corresponding authority, that any such wire is or is likely to become dangerous to the public safety, they may make an order directing it to be removed upon such terms as they may think fit."

(13) "That the local authorities supplying the electric light be required to keep separate accounts of such undertaking, and to publish them in detail for the information of the ratepayers."

(14) "That the Board of Trade be required to submit to Parliament an annual report of their proceedings under this Act."

(15) "That any undertakings which may be authorised by private Acts for the supply of electricity be subject to the conditions contained in this Act."

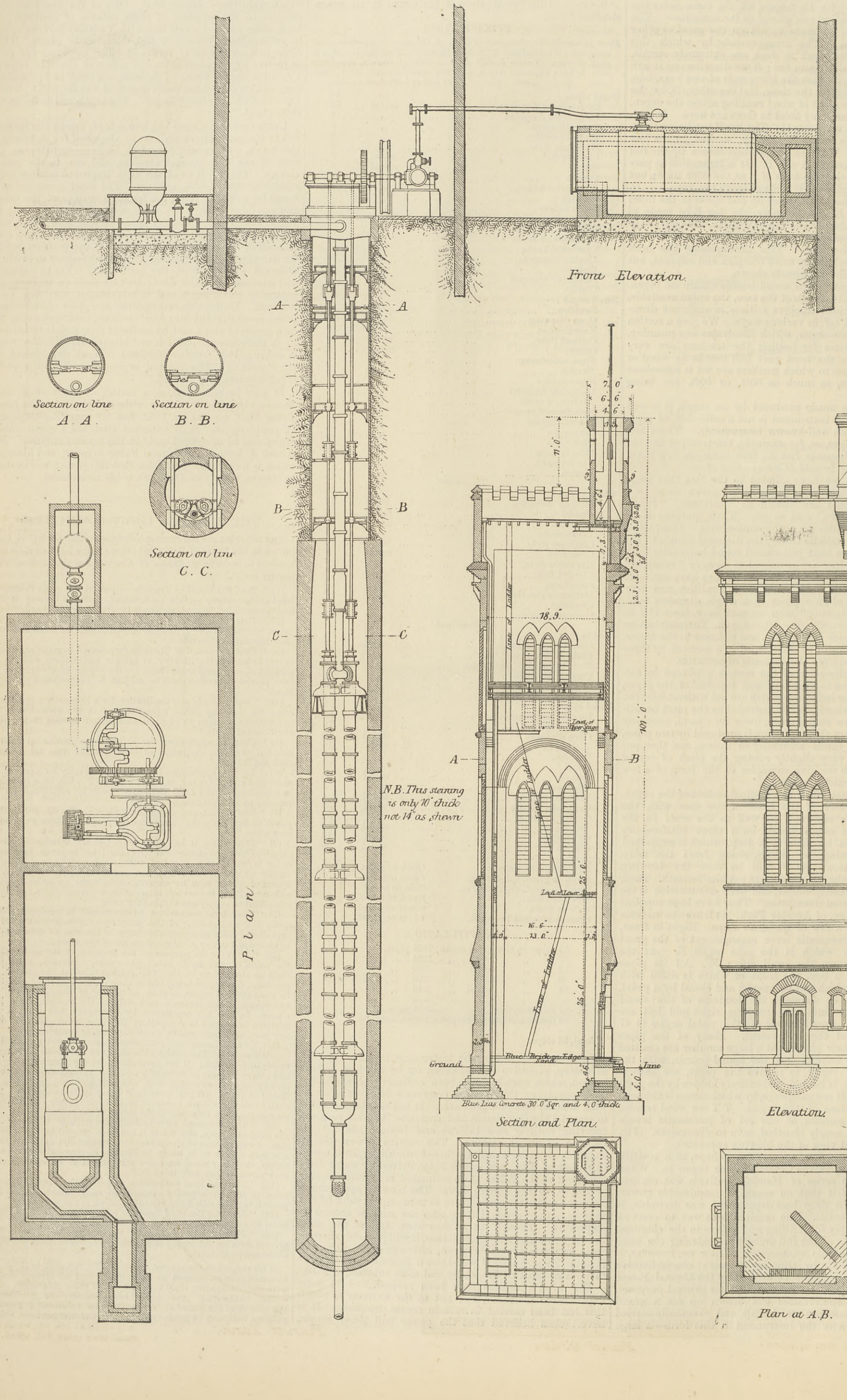
With respect to the several private Bills referred to them, the Committee have decided to recommend that all clauses dealing with electric lighting shall be struck out of those measures.

The Committee met again on Thursday to go through the clauses of the Board of Trade Bill, and to consider any suggestions that may be made upon the above resolutions.

# NEW WATERWORKS, CLACTON-ON-SEA.

MR. JABEZ CHURCH, M.I.C.E., WESTMINSTER, ENGINEER.

(*For description see next page.*)



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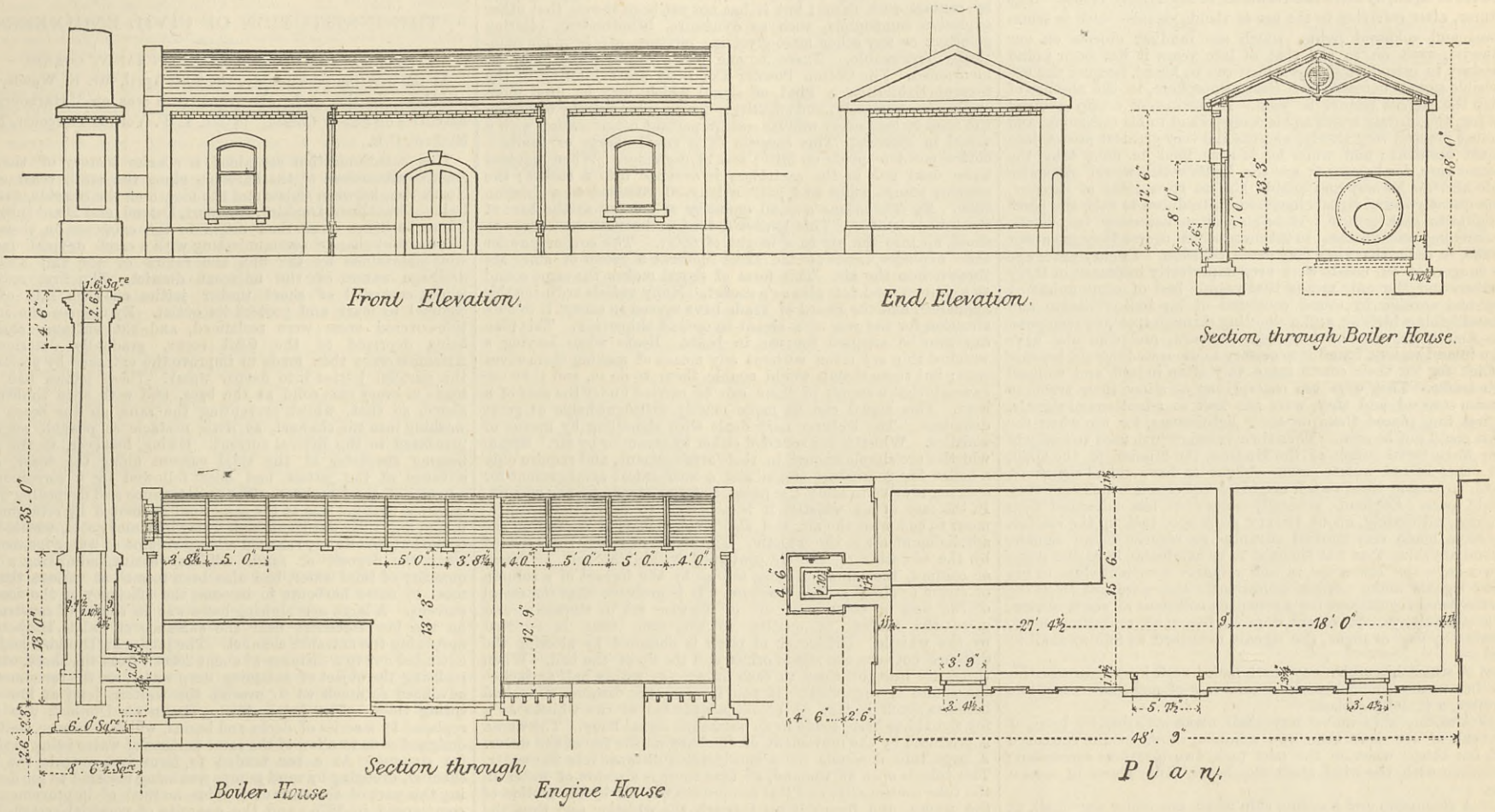



## WATER SUPPLY OF SMALL TOWNS.

No. III.

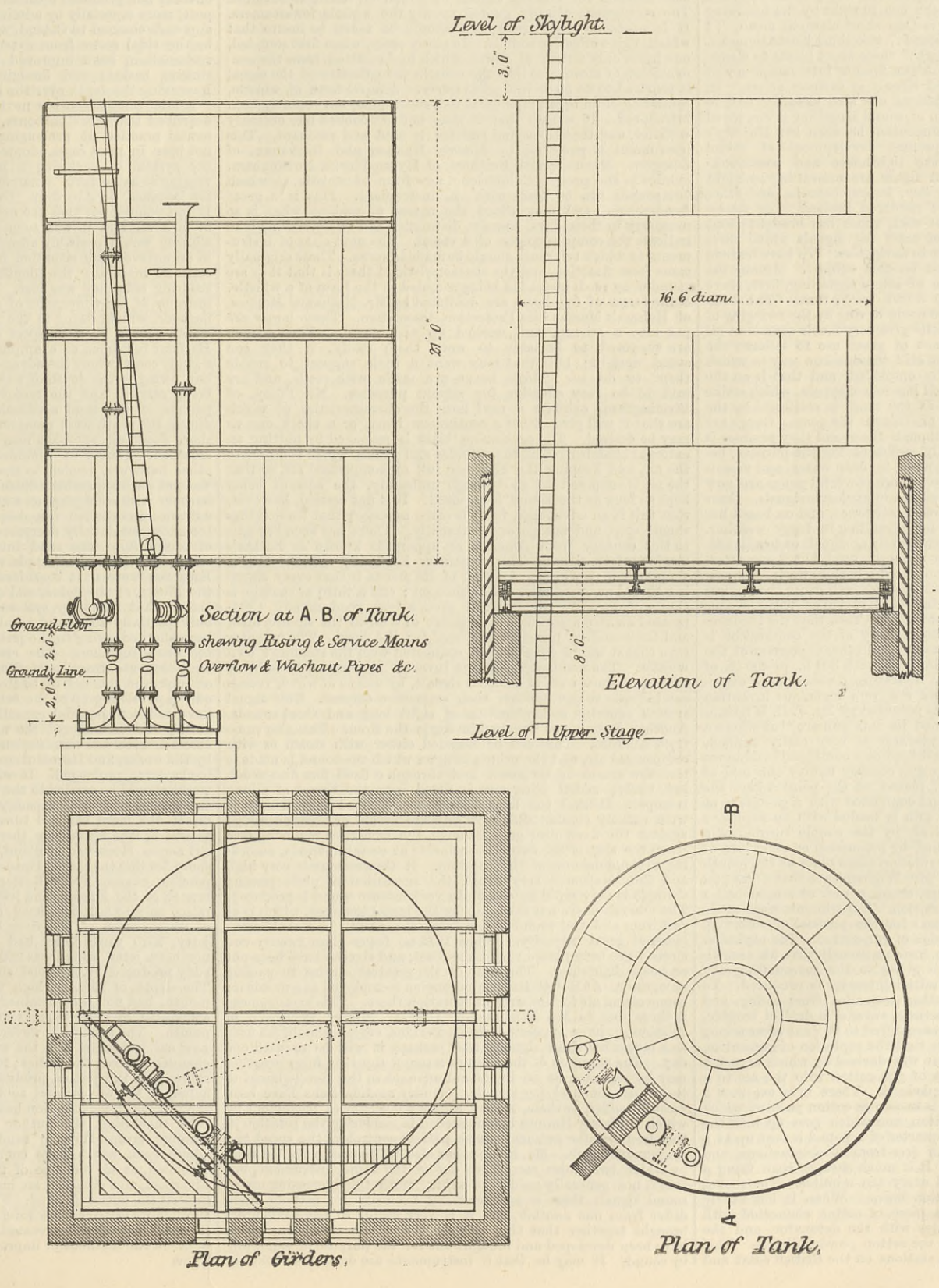
### CLACTON-ON-SEA.

THE importance of an ample supply of good water to every community, and the certainty and cheapness with which it may be obtained for most places suffering from the want of good water, led us to the belief that descriptions of examples of the works of water supply as carried out in a number of small towns under modern ideas and engineering methods would be appreciated. These articles we commenced in THE ENGINEER of the 10th March, p. 181, wherein was described a surface water catchment system, and in that of the 24th March we described a greensand well supply, both works showing what may be done for small communities. We now give engravings on page 396 and 397, and the following description, relating to another example of what may be done to supply small populations with a good water supply at a cost which shows that an ample quantity of potable water should be within the reach of every community in the country.

The Clacton-on-Sea Gas and Water Company was formed in 1876 to meet the requirements of Clacton-on-Sea, which has now become a favourite summer seaside resort. Twenty years since Clacton-on-Sea was but a landing place, consisting of a small village and a landing pier, forming the place of embarkation of the population of a considerable district not then accommodated by the railway which now connects it with the Great Eastern system. It is now placed within an easy journey from London by railway as well as by boat, and during the past six or seven years the number of its visitors has enormously increased. To accommodate these visitors a few capitalists have converted the village into a small town. The gasworks, completed in 1877, and the waterworks, which are the subject of this notice, were designed and carried out by Mr. Jabez Church, M.I.C.E., of Great George-street, Westminster. The water, which is of excellent quality, is obtained from a well sunk into the chalk to a depth of 120ft., with a further boring of 285ft., making a total depth of 405ft. from the surface. The well was constructed in the following manner —28ft. of east iron cylinders 4ft. 6in. internal diameter were sunk through the top gravel into the underlying clay for the purpose of shutting out the surface water; below this brickwork was put in in two half-brick rings, with 1in. of neat cement between them, finishing at the bottom with an invert through which a wrought iron bore pipe is driven to the required depth. The water tower is 101ft. high, and about 27ft. square, built in red bricks with white and black brick string courses. The battlements and top of turret, together with the projecting string courses, are of Bath stone. In the tower, as shown in section on page 396, is a cylindrical wrought iron reservoir supported on wrought iron girders. The valves under the tank and the roof are reached by iron ladders.

The pumping machinery, which is designed so that it can be duplicated at any time, is as follows :—The boiler is a single-tube Cornish boiler 14ft. 6in. long by 4ft. 9in. in diameter. The engine is of the horizontal non-condensing type, having a cylinder 9½in. in diameter by 14in. stroke, with an outer casing for live steam, and fitted with patent variable expansion excentric and quick speed governors, and indicates 20-horse power with 60 lb. of steam. The fly-wheel is 5ft. 8in. in diameter. The pumps are of the ordinary deep-well lift kind, with barrels carried up above water line, so that the valves and buckets can be taken out from the top for repairs, obviating the use of a diver for this purpose. The diameter of the pumps is 8¼in., stroke 19in., fitted with gun-metal buckets and valves; the working barrels are fixed 52ft. under water line, and are actuated by spur gearing carried on a massive moulded cast iron curb of an ornamental character.

There are about 5000 yards of mains. Mr. T. Tilley, of Walbrook, executed the trial bore hole and well and also the main laying. Messrs. H. Young and Co., of London, constructed the machinery and ironwork, and Messrs. Saunders and Son, of Dedham, carried out the brickwork. The cost of the whole of the works, which are of substantial character and of first-class workmanship and materials throughout, including land and parliamentary expenses, was £7700, and as they will amply provide for a summer population of 5000, the cost per head will be only about £1 10s. 9d., which any small town could well afford.



## NAVAL AND SUBMARINE EXHIBITION LECTURES.

### SOUND SIGNALLING.

A LECTURE on "Sound Signals" was delivered on Friday evening, the 14th of April, by Mr. Price Edwards, of the Trinity House. The lecturer, after referring to the use of visible signals—such as semaphores and coloured lights, which are familiar objects on our railways—went on to say that of late years it has been found necessary to introduce signals which can be heard, because the use of visible signals necessitates a clear atmosphere, in the absence of which the signals cannot be seen. In the case of a ship involved in a fog, the captain trusts to his compass and to his reckoning, and he must proceed very slowly, and use the very greatest precautions against accident; and when he is near land he must take the greatest care, for he cannot see the lights which would otherwise guide him on his way and enable him to steer clear of dangers. Consequently sound signals have been introduced to take the place of lights in such a case. It is also often necessary for vessels approaching one another to intimate which course they are about to take, in order that they may avoid collision. Twenty years ago the dangers of our coasts were very imperfectly indicated in foggy weather, and the only means that vessels had of communicating with one another by sound consisted of an indiscriminate and unintelligible whistling, and a shouting through speaking trumpets. The Americans, who have a large seaboard, and who also have large inland waters, found it necessary to use sound signals, because a thick fog on their coasts came very often indeed, and stopped their traffic. They were too enterprising to allow their traffic to remain stopped, and they were the first to adopt sound signals. At first they placed them on their lighthouses, for use when the lights could not be seen. Then their vessels which used to navigate their huge rivers—such as the Hudson, the Mississippi, the Ohio, and other inland waters—were obliged to have sound signals on board, to enable them to tell neighbouring vessels which side they should pass. England, generally somewhat less advanced than America, ultimately, about twenty years ago, took up the matter. We have made very marked advances as regards sound signals, beyond anything that was thought to be attainable in earlier days. Now-a-days the law steps in and requires merchant ships to use sound signals under certain conditions. For merchant ships the international regulations for preventing collisions at sea prescribe, as a compulsory requirement, that in fog, mist, or falling snow, whether by day or night, the signals described as follows shall be used:—

(*a*) A steamship under way shall make with her steam whistle, or other steam sound signal, at intervals of not more than two minutes, a prolonged blast.

(*b*) A sailing ship under way shall make with her fog horn, at intervals of not more than two minutes, when on the starboard tack one blast; when on the port tack, two blasts in succession; and when with the wind abaft the beam, three blasts in succession.

(*c*) A steamship and a sailing ship when not under way shall, at intervals of not more than two minutes, ring the bell. And, as an optional proceeding, a steamship under way may indicate her course to any other ship which she has in sight by the following signals on her steam whistle, viz.:—One short blast to mean, "I am directing my course to starboard;" two short blasts to mean, "I am directing my course to port;" three short blasts to mean, "I am going full speed astern." A gun fired at intervals of about a minute is one of the authorised signals of distress at sea. In the Royal Navy the above regulations are also in force; but, in addition, Captain Colomb's system of sound signalling is employed in fog for the purpose of communication between her Majesty's ships. By far the most important development of sound signals is in connection with the lighthouse and coastmarking service. The most powerful lights are unavailing at night if enshrouded with fogs, and, by day, buoys, beacons, and other marks and signs of the sea are rendered useless. The necessity of sound signals to do duty at such times has brought about the development of the system of coast fog signals which have proved to be of the greatest service to navigators. We have learned a great deal from the Americans on this subject. Among the instruments used for the purpose of sound signalling, first, there are bells, varying in weight from 3 cwt. to 2¼ tons. The bells themselves are fixed, and they are made to ring by the swinging of the clapper or hammer. These bells give very feeble sounds at all times. At a distance they are not of great use to sailors; the sound is not intense enough. But still there is one way in which a bell continues to be very usefully employed, and that is on the top of a floating buoy. Such a bell has four clappers, which strike the bell at four different points as the buoy is oscillated by the waves. Another kind of sound producer is the gong. Gongs are used on board lightships, and although the sound they produce is but small, it is, perhaps, generally sufficient for the purpose, because lightships are generally moored in deep water, and vessels can approach them pretty closely. More powerful gongs are now coming into use. Next there are guns and explosive signals. Guns are used to indicate that vessels want assistance, and on board her Majesty's ships they are used for signalling in foggy weather. They have also been employed occasionally as signals on headlands. The old long 18-pounder gun was formerly used, but it was afterwards found that shorter guns produced a better effect. Experiments have shown that small grain powder will cause the loudest explosion, the reason of this being that it burns with greater rapidity than powder of larger grain. The fact that the loudness of an explosion depends upon the rapidity of the combustion is shown by the detonation of gun-cotton and other explosives of the same nature. An 80-ton or 100-ton fired with 300 lb. or 400 lb. of pebble powder, does not make so distressing a noise as the explosion of 1 lb. of gun cotton. There is a very ingenious invention called the gas gun, which has been patented by Mr. J. R. Wigham, of Dublin. The advantages claimed for this gun are that where a supply of gas is available the apparatus is very easily applied, and that the gun can be loaded and fired at a considerable distance from the point of explosion. The gun consists merely of a tube of about 18in. bore and 12ft. long, placed at the point where the signal is required to be made, and connected with a gas main or gas-holder by iron piping. The gun is loaded with an explosive mixture of gas and atmospheric air by the simple turning of a cock, and is fired by a light applied by percussion or otherwise at the shore end of the tube. The explosion takes place at the mouth of the gun almost immediately. Mr. Wigham says that a gas gun may be fixed at the water's edge, or on a rock at sea, at half a mile from the loading and firing station. Experiments were made some years ago at the Royal Arsenal for the purpose of observing the sound produced by the explosion of gun-cotton. The explosion of this substance takes place so instantaneously that an exceedingly sudden and sharp blow is given to the surrounding air, whereby a sound wave of great initial intensity is produced. To discharge small charges of gun-cotton suspended from string, and with the necessary electric connections, entailed a deal of trouble, and was inconvenient where it was required to be done after a long interval; but it was clearly shown that the explosion of gun-cotton gave a very good sound, and a plan was devised by which a rocket was made to carry up a charge of gun-cotton into the air to a height of 600ft., and there to explode it. There is in use now a sound rocket charged with what is known as cotton powder, which is a slight modification of gun-cotton, and which goes up into the air and makes a great noise. A quarter of a pound is sent up as a charge, and it explodes in the air free from all obstructions, and makes a most effective sound. It is much cheaper than firing a gun. The gun used to be fired every ten minutes. The rocket goes up as long as its composition burns. When it has nearly finished burning it sets fire to a piece of cotton connected with the fuse. The fuse communicates with the detonator, and the explosion communicates itself to the cotton powder charge. This sort of rocket is now used at five stations on the British coast and at Heligoland. For the purpose of distinction some attempts have recently been made to get two distinct explosions from one rocket by sending up two charges together. This idea it is hoped will soon be made practically successful. The cotton powder that is now made may be handled and stored with as much safety as gunpowder, and it is less easily exploded by contact with flame; but it has not yet been shown that other explosive compounds, such as dynamite, lithofracteur, blasting gelatine, or any other nitro-glycerine mixture, can be made practically serviceable. There is one other signal which may be mentioned. The Cotton Powder Company are exhibiting in the present Exhibition a kind of signal which may be fired more easily, expeditiously, and effectively than a gun, thereby obviating the need to load every minute—an important consideration with a vessel in distress. This consists of a small charge of tonite—cotton powder—made up into a sort of cartridge. When required to be used one of the cartridges is dropped into a socket; the seaman stands aside and pulls a lanyard attached to a friction tube. By this means a small quantity of powder at the base of the tube is ignited. This ignites a fuse, and causes the charge to shoot up into the air to a height of 600ft. The cotton powder then explodes, and at the same moment a group of stars are thrown into the air. This form of signal makes the same sound as a cannon, and acts also as a rocket. Many vessels are using this appliance, and the Board of Trade have agreed to accept it in substitution for the gun as a signal in case of shipwreck. This plan can also be adopted for use in boats. Boats when leaving a wrecked ship are often without any means of making themselves seen; but these signals would enable them to do so, and they are so small that a supply of them can be carried under the seat of a boat. This signal can be made readily distinguishable at great distances. The lecturer next dealt with signalling by means of whistles. Whistles are sounded either by steam or by air. Steam whistles are simple enough in their arrangement, and require only a boiler for generating steam and a mechanical arrangement for opening a valve to allow the passage of the steam to the whistle. In the case of air whistles it is necessary to have some arrangement to compress the air, and also some means of regulating the admission of air to the whistle. The sound of a whistle is caused by the vibration of the air contained within the bell, or dome, or column, the vibration being set up by the impact of a column of steam or air at a high pressure. Is is probable that the metal of the bell or column of air is likewise set in vibration, and gives the timbre or quality to the tone that is emitted by the whistle. Difference of pitch is obtained by altering the distance between the steam orifice and the lip of the bell. When these are brought close to each other—say within half an inch—the sound is very shrill. If you increase the distance the sound becomes much deeper. A recent adaptation of the whistle as a fog signal has been made in an automatic signal buoy. The sound is produced by the movement of the buoy on the top of the water. A large tube descends for a considerable distance into the water. This tube is open at the end, so that there is a piston of water in the tube continually, and this compresses the air by the motion of the waves, and forces it up through the whistle; and thus the whistle is continually sounded. Whistles are supposed to be the best medium for making signals by sound on board steamships. The regulations already quoted specify the whistle for steamers. It is necessary that precaution should be taken to insure that whistles give effective sounds. In many cases, when first sounded, one hears only a rush of water, which has resulted from the condensation of steam; so that the whistle is ineffective if the signal is required to be made in a great hurry. A novel form of whistle, consisting of an organ pipe fitted to a steam pipe, has recently been introduced. It is said that it does not get choked like ordinary whistles, and that the sound emitted is loud and resonant. This instrument is patented by Messrs. Hannen and Buchanan, of Glasgow. Messrs. Smith Brothers, of Hyson Works, Nottingham, exhibit in the present Exhibition a new form of whistle, in which two sounds can be made with one instrument. This is a great desideratum, and may afford the means of making what is so necessary in these days, namely, distinctive and effective signals to indicate the compass course of a vessel. The next class of instruments to which reference should be made is horns. These originally came from America, and the characteristic of them is that they are sounded by reeds instead of being sounded in the form of a whistle. Some forms of fog horns are exhibited by Mr. Nathaniel Holmes, of Holmes's Marine Life Protection Association. These horns are put into a stirrup, and worked up and down. The seamen are supposed to be able to work them easily, if they can stand upright; but that may want a little support to enable them to do so. These horns are made with reeds, and are said to be very effective for certain purposes. Mr. Pilley, of Birmingham, exhibits a reed horn the characteristics of which are that it will give either a continuous blast, or a short one as may be desired. The continuous blast is managed by putting an external chamber round the cylinder and piston, which compresses the air, and keeping the chamber full of compressed air, so that the air is supposed to go through uniformly, the current being kept so long as the sound is required. It is not certain, however, that this is an advantage, for it is often necessary that these things should stop, and not go on continually. There has been brought to this country from America an apparatus known as Barker's marine safety signal. This apparatus has many merits. One is simplicity of working. Another of its merits is that every signal is sounded automatically when once set; and a third advantage is that with the horn attached it gives a very good sound. Compressed air is employed at a pressure of 6 lb. to the square inch, and the sounding principle is a reed for the horn. The inventor says that it can be equally well connected with the steamer's own whistle. The main object of the inventor appears to be to bring into use a short code of compass signals, by means of which vessels can indicate to one another their respective courses. This signal system contains a combination of eight long and short sounds. Another instrument for use in fog is the siren. This also came from America. This can be sounded either with steam or with compressed air, and the principle upon which the sound is made is that the steam or air passes first through a fixed flat disc which has twelve radial slits, and is fitted into the throat of a long trumpet. Behind the fixed disc there is fitted a revolving disc with exactly similar slits. A pressure of air or steam directed against the fixed disc goes through the second or revolving disc when the slits of the two discs coincide at certain periods, according to the quickness of the rotation. If the pressure is very high and the rotation is very rapid, the succession of puffs passing through is very rapid indeed, and a very intense sound is produced. The vibrations are not taken up by the metal trumpet, which is of cast iron, and the sound issues from the mouth in a continuous beam of great intensity. Since 1874 no fewer than twenty-two sirens have been placed round our coast, and sixteen have been put on board lightships. These are of the greatest service to passing navigation. At Howth Bailey a gas engine is employed as a motor for compressing air for the siren in operation there. This arrangement is there due to Mr. Wigham, of Dublin. Messrs. Stevenson, of Edinburgh, have suggested that a Perkins engine should be used as a motor for siren signals, and perhaps it will be so used one day. The adoption of the siren as a sound signal in foggy weather may be regarded as an important advance in the development of these instrumental fog signals. Sundry modifications have been recently added to them, among others a mechanical movement by which Professor Holmes has succeeded in rendering the rotation of the siren cylinder automatic with perfect control of the speed and consequent pitch. Mr. Holmes has also introduced a double siren by which two notes can be got out of the same instrument, but this is not generally used at present. With the increasing use of sound signals there is an increasing necessity for making them differ from one another, and it is very useful to have inventors brought together that they may see the various inventions which have been developed and brought out for the purpose of signalling by sound. It may be that if instruments are devised sufficiently accurate to make sound signals which shall be trustworthy and useful, ultimately the law will be altered to suit those instruments; but inventors must not expect that a change in the law will be made in favour of their own particular instruments.

## THE INSTITUTION OF CIVIL ENGINEERS.

### HARBOURS AND ESTUARIES ON SANDY COASTS.

AT the meeting on Tuesday, the 25th April, Mr. E. Woods, vice-president, in the chair, the paper read was on "Harbours and Estuaries on Sandy Coasts," by Mr. L. F. Vernon-Harcourt, M.A., M. Inst. C.E.

This communication contained a concise history of the progressive alterations of the harbours along the south coast of the North Sea, between Calais and the mouth of the Scheldt, namely, Calais, Gravelines, Dunkirk, Nieuport, Ostend, and Blankenberghe. These harbours owed their origin to the existence on their sites of an outlet channel communicating with a creek or small lagoon, and maintained by the flux and reflux of the tide and the drainage waters of the adjacent district. The first artificial works consisted of short timber jetties on each side of the channel to mark and protect its outlet. By degrees the inland tide-covered areas were reclaimed, and the entrance channel being deprived of the tidal scour, gradually deteriorated. Attempts were then made to improve the entrance by prolonging the parallel jetties into deeper water. These jetties had been made in every case solid at the base, and with open timberwork above, so that, whilst preventing the sand on the beach from washing into the channel, as little obstacle as possible might be presented to the littoral current. Owing, however, to the sand-bearing character of the tidal current along the coast, every advance of the jetties had been followed by a corresponding advance of the foreshore. The maintenance and deepening of the entrance channel was at the same time promoted by retaining the inland and tidal waters at high water by sluice gates, which, being opened at low water, released a large volume of water for scouring away the deposit of sand. Sluicing basins, admitting a large quantity of tidal water, had also been formed at various times in most of these harbours to increase the efficiency of the scouring current. A large new sluicing basin was in course of construction on the low foreshore near the entrance of Calais Harbour for deepening the entrance channel. The jetties at Dunkirk had been extended out to a distance of about 2500ft. from the shore, without realising the object of attaining deep water, as the foreshore had advanced so much as to overlap the western jetty at low-water spring tides. The large sluicing basin at Dunkirk was being replaced by a series of docks and basins, which, however, had been designed so as to allow of the same amount of water being available for sluicing. As a bar tended to form just outside the jetty channel, dredging by sand pumps was being resorted to for deepening this part of the entrance. This method of improvement was commenced in 1876; and the quantity of material removed last year amounted to about 314,000 cubic yards. The deepening thus effected had produced a considerable increase in the trade of the port, more especially by admitting vessels of larger tonnage. The approach channel to Ostend, which was maintained in former times by the tidal scour from extensive marsh lands, had, since their reclamation, been improved by parallel jetties and well-placed sluicing basins; and dredging was now being resorted to for improving the depth over the bar beyond the jetties.

A brief comparison was next drawn between the jetty harbours described and other harbours, and it was shown that the continental practice of prolonging parallel jetties and sluicing had not been in most cases adopted in the United Kingdom, but that the system of enclosing a large tidal area by solid piers converging so as to form a narrow entrance had been preferred, as, for instance, at Aberdeen, Dublin, Sunderland, and Lowestoft. It was pointed out that the extension of parallel jetties had proved of no avail, and it was suggested that converging piers aided by sluicing would probably afford the best prospect of maintenance in an unfavourable situation like Dunkirk, whilst dredging would serve to maintain the depth outside the entrance where the scouring efficiency was lost. Boulogne Harbour was cited as an instance of the conversion of a jetty harbour into a large closed harbour, which, owing to the projection of its entrance into deep water, gave a good prospect of successful maintenance. Madras Harbour furnished an example of a closed harbour constructed on a sandy coast, where the advance of the foreshore had been dreaded; but, owing to the depth of water—45ft.—into which the piers were being carried, and the removal by the north-east monsoon of a portion of the sand accumulated against the south breakwater during the south-west monsoon, it seemed probable that the foreshore would not approach near the entrance for a long period. The experience gained at Ymuiden, Port Said, Madras, Karachi, and other harbours, tended to show that a considerable littoral drift was not an insuperable obstacle to the effective maintenance of a harbour with solid piers on a sandy beach. For, provided that the entrance was carried into deep water, the rate of advance of the foreshore continually decreased, and might even reach a position of equilibrium; the sand introduced through the entrance was small, and the projecting piers tended to produce a scour in front. Estuaries were next considered, and the works at the mouths of the Adour, of the Seine, and of the Maas, were discussed. It was shown that the jetty system adopted for the Adour had been only partially successful, and that the influx of the tide had been checked owing to the jetties at the mouth having been placed too close together. The restriction of the tidal Seine within embankments, from La Mailleraye to Berville, though producing an improved channel up to Rouen, had caused such an unexpectedly rapid silting up of the estuary as, within thirty-three years, to have reduced the tidal capacity of the Seine by 272,000,000 cubic yards, and endangered the approaches to Havre. The shifting channel below the termination of the banks had not been improved by the works, and its maintenance would be imperilled unless the banks were prolonged. It was suggested that the embankment works should be carried to the mouth, in such a manner as to reduce the diminished tidal capacity as little as possible, and so as to direct the main channel towards Havre. The works at the new mouth of the Maas were then referred to. They consisted of a cut across Hoek-van Holland, with jetties at right angles to the shore, leading the channel into deep water, and providing the shortest possible channel from Rotterdam to the sea, along the Scheur branch of the Maas. The jetties, composed of fascine work, were raised only to half-tide level, and slightly diverging formed a sort of prolongation of the river banks into the sea. The southern jetty, 2515 yards long, had been made to project beyond the northern jetty, which was 2200 yards long, in order to prevent an eddy produced by the flood current, which tended to raise a bar. The depth of 23ft. at high water, which was anticipated at the mouth, had not been attained. The deficiency in depth had been attributed by some persons to a too rapid widening out near the mouth. The author, however, ascribed it to the narrowness of the new cut compared with the width of the river above, and of the channel between the jetties; to the natural progression of the foreshore, near the jetties, produced by the littoral currents and the action of the waves; and to the material scoured from the cut in the process of construction having remained near the jetties.

In conclusion, the author discussed the general question of training rivers through sandy estuaries, and pointed out that where such works were commenced they had gradually to be extended, as in the case of the Fen rivers. The Mersey, above Liverpool, was cited as an instance where training works might imperil the outlet channel. The proposals for training the Scheldt through its estuary were referred to, and any great reduction of its tidal capacity deprecated. Lastly, a comparison was made between the methods of improving the outlets of the Maas and the Tyne.

## RAILWAY MATTERS.

THE boring of the Arlberg tunnel is proceeding rapidly, the rate of advance averaging ten metres daily, which exceeds the average made with the St. Gothard by six metres. At this rate boring is expected to be completed before the end of 1883.

A LARGE and enthusiastic meeting was held at Wrexham on Wednesday evening to protest against the action of a committee of the House of Lords in arbitrarily throwing out, without hearing all the evidence of the promoters, a Bill for the provision of better railway and dock accommodation in North Wales, and for the construction of a central station in Wrexham.

ON and after June 1, the trains on all sections of the Great Western Railway, with the exception of the "Flying Dutchman" and the limited mail trains, will carry passengers at third-class or Parliamentary fares. This concession does not include the Bridport companies line. Minor alterations in some of the fares between stations west of Bristol will gradually be put in force.

A VALUABLE illustrated pamphlet entitled, "Railway Accidents; their Cause and Prevention," by Mr. Clement E. Stretton, is being published by Messrs. Simpkin, Marshall, and Co., London, and by Messrs. Spencer, Leicester. The author makes a digest of the causes, results, and verdicts on various illustrative railway accidents, and then discusses the relative value of different systems of signalling and of continuous brakes. Mr. Stretton takes up the railway accident question from the passengers' and engine-drivers' standpoints, and being an independent observer his views are entitled to consideration.

THE Select Committee of the House of Commons has passed the Bill authorising the Solway Junction Railway Company to raise sufficient capital to reconstruct the viaduct across the Solway Firth. The new viaduct will be 1 mile 180 yards in length. The old one was broken down by a mass of icefloes in January of last year, as described by us at the time. Since then the English and Scotch sections of this company's railways have been altogether disconnected. The new bridge will be constructed under the direction of Mr. Brunlees, C.E., with wrought iron columns instead of cast iron.

THE second section of the Hundred of Hoo Railway will be opened for traffic in the course of a few weeks. The pier at Grain, which is 400ft. long, is almost completed. There are three lines of rails upon the decking, with the usual apparatus and appliances for unloading ships. The pier has been constructed in deep water, there being 20ft. of water at low tide, so that large merchant ships, and even ironclads of moderate size, could come alongside at any time, irrespective of the tide. One disadvantage of the site, however, is that it is particularly exposed to the full force of inclement weather and rough seas. The object of the directors of the South-Eastern Railway Company in building the pier is to open up a new traffic with Belgium and the north of Europe.

FROM a recently published report upon Indian railways for 1880-81, it appears that at the commencement of 1881 there were 9619 miles of railway open to traffic, and 646 under construction. During the past year 318 were open to traffic, and the commencement of 1482 miles was sanctioned. At the present time, therefore, 9937 miles are open for traffic, and 1482 in course of construction. The total capital outlay on railways to the end of 1883 will be £138,937,000, namely, £68,292,000 on guaranteed railways, £31,852,000 on State lines, and £38,793,000 on the East India Railway. It is estimated that the last undertaking will have yielded a net profit to Government of £4,133,000 from the time when it was taken over by the State to the end of the financial year. The net charge on account of the guaranteed lines for 1882-83 is estimated at £261,000, compared with £115,000 in 1881-82. The net charge on account of the State lines for 1882-83 is estimated at £206,000.

FOR Europeans returning from the East *viâ* Naples, the St. Gothard, Basle, Ostend, or Calais route will be a pleasant one, Naples being a beautiful resting-place, and with some improvements on the different lines the journey could be considerably shortened. At present it takes from Naples to Milan 25 hours; Milan to Basle, *viâ* the St. Gothard, 12 hours; Basle to Brussels, 12 hours, and five more to Calais—making in all 54 hours. This is shorter than the route *viâ* Marseilles by seven hours, besides the avoidance of the often rough sea in the Gulf of Lyons. With improvements in the railway lines of Maremma, the line in course of construction from Spezia to Parma, and the realisation of the projected direct route from Rome to Naples *viâ* Gaeta, the journey need not occupy more than 40 hours from Naples to Calais—24 hours shorter than the Marseilles route, and so much sea voyage saved. The *Daily News* Naples correspondent says the question of the direct line to Rome is exciting great interest there, and in a few days a meeting is to take place with the object of urging its realisation. It is also desired that the question of one or more new stations should be discussed, as the present one would then be insufficient, and even now is inconveniently far from many parts of the city.

IN his report on the trade of Antwerp during last year, Mr. Consul Grattan points out that the preponderance of that port over the other ports of Northern Europe is likely to be increased rather than diminished by the opening of the Gothard Tunnel, as Belgium will in all probability profit by the transfer to this shorter and cheaper commercial highway of much of the international transit trade at present monopolised by the French lines *viâ* the Mount Cenis Tunnel. The overland traffic between North-Western Europe, and especially England, and Italy, India, and the Levant, will, of course, be chiefly affected. Mr. Grattan gives the following comparative statement of the distance from the several ports to Milan, *viâ* the rival railway routes:—Calais to Milan, *viâ* Mont Cenis, 846 miles; Boulogne to Milan, *viâ* Mont Cenis, 849 miles; Ostend to Milan, *viâ* St. Gothard, 786 miles; Antwerp to Milan, *viâ* St. Gothard, 736 miles. From this it will be seen that Antwerp possesses an advantage of 83 miles over Boulogne and 110 miles over Calais. The route under the Simplon, which France proposes as a set off to the St. Gothard route, would shorten the distance from Calais to Milan to 774 miles, and from Boulogne to Milan to 746 miles, so that Antwerp would still have an advantage of 38 miles over Calais and 10 miles over Boulogne. The traffic rates through France are, moreover, higher than on the Belgian and Alsatian lines.

WE have received a copy of a pamphlet of very considerable dimensions containing "facts from experience" with Cleminson's flexible wheel base rolling stock. The facts extend over six years of working of the system as applied to carriages and wagons over the greater part of the world, and of gauges ranging from 23¾in. on the North Wales Narrow-gauge Railway, to 6ft. as on some of the Australian lines. We have already fully described Mr. Cleminson's system as applied to the royal saloon carriage on the South-Western railway and on many other railways, in our impression of the 15th February, 1878, and since referred to its application at home and abroad. The pamphlet shows that the system is working with complete success and economy on 150 railways, consisting of 25 home, 95 foreign, and 30 colonial lines, and on these lines there are running 26 engines fitted on the system and over 4000 carriages and wagons, while it appears that there are now over 100 engines building on the system and 2000 carriages and wagons. The advantages of the system are chiefly safety and ease in passing round curves, reduced wear and tear of rails and flanges, and an increased carrying capacity in some cases of 35 per cent., with a reduction in weight of 25 per cent., as compared with rigid axle rolling stock. By the use of three pairs of wheels on the system, long carriages may be used, as they are completely supported from end to end, and follow curves much more smoothly than the ordinary short wheel base stock. These advantages are, it is plain, being fully appreciated, as besides new stock a good deal of old stock has been altered to the system.

## NOTES AND MEMORANDA.

IN Bulgaria a post-office has, on an average, to deal with about 16,000 letters annually, an English one has 107,000, a German one 85,000.

M. PIERRE MANCHES says he has found that when sulphurous acid is passed into water through which an electric current is conducted, the sulphur is deposited as a yellowish-white powder on the negative pole.

THE Census Bureau revised report of the United States population statistics shows an area of 2,900,170 square miles. The population is 50,155,783, the number of families 9,945,916, and of dwellings 895,512, being an average of 17¼ persons to each square mile.

THE following were the revenues of the Australian colonies at the end of 1881:—New South Wales, £4,904,230; Victoria, £4,621,282; South Australia, £2,027,964; Queensland, £1,612,314; Tasmania, £439,780; Western Australia, £180,050; New Zealand, £3,283,396; total, £17,069,016.

THE proportion of revenue raised in 1881 by taxation on machinery in the Australian colonies was as follows:—New South Wales, £1,417,293; Victoria, £1,690,923; South Australia, £529,450; Queensland, £600,236; Tasmania, £304,546; Western Australia, £95,510; New Zealand, £1,535,700; total, £6,173,658.

THE fastest ocean passage on record was recently made by the Guion steamer Alaska, when she ran from New York to Queenstown in seven days fifty-three minutes. Her outward passage occupied seven days four hours forty-two minutes, making the round voyage of out and home in fourteen days five hours and thirty-five minutes.

A NEW explosive has been invented by M. Petri, a Viennese engineer. The name given to it is dynamogen, and, according to the *Neue Militarische Blatter*, it is likely to compete seriously with gunpowder. The inventor states that it contains neither sulphuric acid, nitric acid, nor nitro-glycerine. The charge of dynamogen is in the form of a solid cylinder, which can be increased in quantity without being increased in size, by compression. The rebound of the guns with which the new explosive has been tried is said to have been very slight. It is also said that the manufacture of dynamogen is simple and without danger, that it preserves its qualities in the coldest or hottest weather, and that it can be made at 40 per cent. less cost than gunpowder.

STANNOUS hydrate may lose its water and become transformed into crystals of the anhydrous oxide under circumstances which are complex and imperfectly known. The crystallisation may occur either in acid or alkaline liquids. The acids with reference to oxide of tin may be divided into two groups. Those of the one group give, with this oxide, salts which are entirely decomposed by boiling water, and determine its transformation into the crystalline oxide in consequence of successive reactions. These salts, decomposable by water, yield free acid, and behave absolutely like the acids themselves, determining the crystallisation of stannous oxide. The acids of the second class do not give rise to these successive reactions, and the hydrated stannous oxide never becomes anhydrous and crystalline under their influence.

THE total number of persons engaged in the European postal service in 1880 was 250,665, of which Germany has 72,303; France, 45,444—but these two include telegraph officials; England, 34,644; Austria-Hungary, 18,676; Italy, 15,813; Russia, 14,985, &c. The postal service in the whole of Europe brings in a surplus of about £5,750,000—this includes the telegraph service in Germany, France, and Roumania. England has the lion's share, about 2½ millions; then follow France, Germany, Spain, Italy, &c. Russia and Roumania show considerable deficits, and the Bulgarian deficit is 65 per cent. of the total expenditure. The postal traffic of Europe has increased from 3,957,850,639 articles in 1873 to the figure above given, or 58·8 per cent. in eight years. At this rate in 1888 it should amount to some 13 milliards. The percentage increase in the last eight years has greatly exceeded that of the population, which is only 7 to 8.

AN alleged invention of a German chemist, by which cotton and woollen fabrics could be coated with a layer of dissolved silk and made to assume the glossy and soft appearance of actual silk goods, was recently described by the *Colonies and India*. Experiments in a somewhat similar direction appear to have been made by a French chemist, who, however, coats his material with a thin layer of tin instead of silk. He first makes a mixture of zinc powder and dissolved albumen, which he spreads over the fabric by means of a brush, leaving it to dry, when the stuff is passed first through superheated steam, and afterwards through a solution of chloride of tin. By this means an exceedingly thin layer of tin is spread over the whole side of the fabric, which is thus rendered waterproof, and protected against ordinary rough usage. The utility of the invention probably consists in the preparation of theatrical dresses, and even in the bright "trimmings" the invention might find a limited application.

FROM a return published by the Government Statist of Victoria, it appears that, of the 862,346 people who comprised the whole population of this part of Australia, 499,199 were born in the colony itself, 147,453 in England and Wales, 48,153 in Scotland, and 86,733 in Ireland. Of persons born in the Australasian colonies other than Victoria, 11,876 came from Tasmania, 9928 from South Australia, 9826 from New South Wales, and 6000 or 7000 from all the other colonies together. All other British possessions claim between them 7148, of whom 1118 were Canadian born, 998 East Indians, 1877 born at sea, and 4707 vaguely described as "British." Of foreigners, the greatest number are Chinese, viz., 11,799; Germany comes next with 8571; Americans third, with 2343; Swedes and Norwegians fourth, with 1375; French fifth, with 1334; Swiss sixth, with 1314; Danes seventh, with 1039; and Italians, just under the thousand, with 947. No other country claims to be the birthplace of so many as 400.

IT has already been mentioned in this column that certain materials in a state of fine subdivision may be compressed into metallic masses. W. Spring has shown, in the *Berichte der deutsch. chem. Gesell.*, that, when a mixture of bismuth filings, cadmium, and tin, in the proportions necessary for the formation of Wood's alloy, is subjected to a pressure of 7500 atmospheres, the mass thus obtained powdered and again subjected to the same pressure, a metallic block is formed which has all the physical properties of the alloy. Its specific gravity, colour, hardness, brittleness, and fracture are the same; and when thrown into water heated to 70 deg. it melts at once. In like manner Rose's metal was made by subjecting the proper mixture of lead, bismuth, and tin to high pressure. If zinc and copper filings are repeatedly subjected to pressure, a mass resembling brass is finally obtained. If, however, on the other hand, the attempt is made to "squirt" brass, zinc and tin will be squirted, and the copper remain.

A SOFT alloy which will adhere so firmly to metallic, glass, and porcelain surfaces that it can be used as a solder, and which is invaluable when the articles to be soldered are of such a nature that they cannot bear a high degree of temperature, consists of finely pulverised copper or copper dust, and is obtained by resolving copper sulphate, or vitriol of copper, into its original elements, by means of metallic zinc. 20, 30, or 36 parts of this copper dust, according to the hardness desired, are place in a cast iron or porcelain-lined mortar, and well mixed with some sulphuric acid having a specific gravity of 1·85. Add to the paste thus formed 70 parts (by weight) of mercury, constantly stirring. When thoroughly mixed the amalgam must be carefully rinsed in warm water to remove the acid, and then laid aside to cool. In ten or twelve hours it will be hard enough to scratch tin. When it is to be used it should be heated to a temperature of 375 deg. C., when it becomes as soft as wax by kneading it in an iron mortar. In this ductile state, the *Scientific American* says, it can be spread upon any surface, to which, as it cools and hardens, it adheres very tenaciously.

## MISCELLANEA.

THE Royal Agricultural Show at Reading commences on Monday, 10th July, and closes on the following Friday evening.

A NEW Town Hall, Free Library, Reading-room, and School of Science and Art, costing about £60,000, were on Wednesday opened at Reading.

AT the coming Congress of the Sanitary Institute of Great Britain at Newcastle-upon-Tyne, Captain Douglas Galton, R.E., C.B., will be president.

THE prospectus is issued of the Ship Raising and Salvage Association. The company is to be formed with a capital of £100,000 for acquiring Messrs. Clark and Standfield's English and foreign patent rights for raising vessels and removing submarine obstructions.

A COURSE of eight elementary lectures on "Strains in Ironwork, is to be given by Mr. Henry Adams, Assoc. M. Inst. C.E., in the hall of the Society of Engineers, 6, Westminster-chambers, S.W., on Tuesday and Friday evenings, 6.30 to 8 p.m., commencing this (Friday) evening, 2nd June.

IN the submarine operations connected with the raising of the vessel La Provence, sunk in the Bosphorus, a telephone was added to the diver's dress, one of the glasses of the helmet being replaced by a copper plate, in which a telephone was inserted, so that the diver had only to turn his head slightly in order to receive his instructions and report what he saw.

WE understand that the Dee Oil Company, of Leadenhall-street, E.C., and Saltney, near Chester, has just succeeded in obtaining the contract for the years 1882-3 for the whole consumption of cylinder oil for H.M. Admiralty. This is the third year in succession that the company has obtained this contract. The India Service Royal Mail Steamship Company and the London and North-Western Railway Company's Holyhead boats are also using it in preference to any other valve or cylinder oil.

THE work of lifting the new great bell at St. Paul's was completed at noon on the 31st ult., the actual operation having taken fifteen hours. At one o'clock timbers were put under the bell across the opening in the vaulting of the tower to support it, and to enable the ropes to be removed. These supports were in position, and the bell was gently lowered upon them at half-past one, taking its seat firmly with a slight creaking noise as the beams felt the heavy burthen settling itself upon them. To-morrow "Great Paul" may be expected to be heard.

THE Council of the Society of Telegraph Engineers have determined that the Society shall offer three premiums annually for the best original paper sent in to the Society on telegraphic or electrical subjects during the session by any person not being a member of the Council of the Society. The first premium will be called the Society's premium, value £10; second premium will be called the Paris Electrical Exhibition premium, value £5; third premium will be cabled the Fahie premium, value £5. The premiums will consist of books or scientific apparatus. The first premiums will be awarded in 1883 for the best papers sent in between this date and the end of May next.

IN Austria many of the roads are under the supervision of the Government, and the money required for them is stated in the Council Budget. The material used for mending the roads in Lower Austria is of a very inferior quality, so much so that some years ago a reward was offered for the discovery of some suitable and more solid substance, but without practical result. In Bohemia really good material—basalt—is obtainable, also in Moravia, Silesia, and the Tyrol, where granite, gneiss, and hard limestone are available. The total length of State roads is 15,275 kilos., and a decree of 1843 ordered that these roads should have a maximum width of 9·48 metres—30ft. More recently this has been increased to 12 metres.

STEPS are being taken by the Dover Town Council and the Dover Harbour Board to endeavour to induce the London and Chatham Company to transfer their Flushing service to Dover permanently. If this were done it would necessitate the construction of additional dock accommodation in order to be able to berth the vessels in the harbour, there being ample room at the Admiralty Pier for embarking and discharging passengers. The most important alterations, however, would be in the goods department of the service, the accommodation for the examination by the Customs officials of consignments of goods being inadequate to the requirements. The Council and Harbour Board have offered to give the company every facility to enable them to provide the necessary accommodation at Dover, so that the vessels may continue to run from Dover, which port they have been using since the destruction of the Queenborough Pier.

ENGLAND imports some 10,000 tons of cork per annum, and the quantity is yearly increasing, notwithstanding the introduction of many stoppers and substitutes for corks, such as plugs of wood, whose fibres have been specially softened for the purpose, india-rubber, and other materials. The French Government are giving special encouragement to the plantation of the cork-oak in Algeria, and the same thing will, no doubt, be done in Tunis; but, the *Colonies* says, the tree will grow equally well in India, Central America, the West Indies, many parts of Africa and Australia, and in the South Sea Islands, the planters in our possessions there might lay the foundation of a profitable industry by introducing some of these trees and starting their systematic cultivation. The tree, besides being a most valuable one and easily cultivated, is of magnificent growth, and would form an ornament in any landscape.

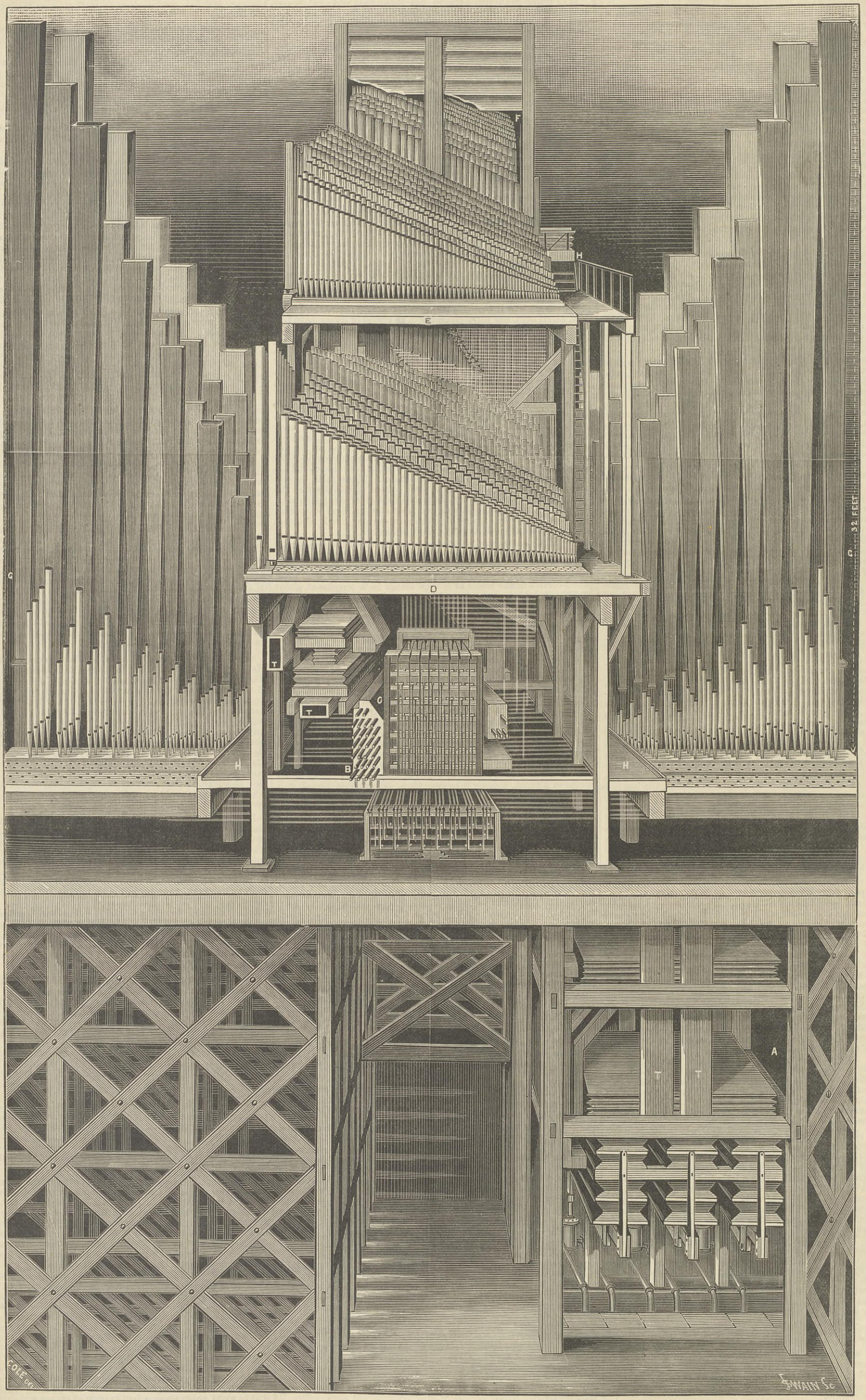
IT is stated that a new lamp combining gas and electricity, giving remarkably economical results, has been brought out. It will be remembered that some years ago gas burners were not uncommon which had a small piece of platinum foil arranged on the burner so as to be burned in the flame. When this was heated by a gas flame, it, by a regenerative action, heated the gas coming from the burner, and caused an improvement in the light. The new lamp is essentially, it is stated, this burner arranged so that a small current of electricity is passed through the platinum. The gas is first lighted, and this heats the platinum, the resistance of which is thus increased, so that a current which would when the platinum is cold, be freely transmitted, now heats the platinum to incandescence, and thus in turn heats the issuing gas to a very high temperature, so that a light equal to 30 candles is, it is said, obtained by the consumption of 2 cubic feet of gas per hour, and a small electric current. If this is the case, the existing gas fittings are all utilisable, and a secondary battery of no great number of elements, and charged with a current of about 2½ volts E.M.F., would supply the current needed.

ACCORDING to a copy of the rules relating to the grant of lands in the Tavoy district of British Burmuda, which we have received from the Secretary of State for India through Sir Louis Mallet, waste lands, covered at present with forest, bamboos, or grass, are available for plantations of coffee, tea, cinchona, or spices at altitudes varying from 100ft. to 6800ft. above the sea in the Tavoy district. This region is between the 13th and 14th parallels of north latitude, and the rainfall ranges from 190in. to 220in. a year. The lands are mostly within thirty to fifty miles of the steamer station of Thayetchoung on the Tavoy river. Mail steamers ply between Thayetchoung and Moulmein or Rangoon once a week inwards and outwards, beginning from the 1st January, 1882. Grants of land in lots ranging from 100 to 1200 acres can be had for planting tea, coffee, cinchona, or spices on application to the Deputy-Commissioner of Tavoy. Copies of the Act and rules can be obtained by intending planters on application to the Deputy-Commissioner of Tavoy, the Commissioner of Tenasserim at Moulmein, or the Secretariat, Rangoon. A grantee will become proprietor of his grant as soon as he brings under cultivation one-third of the area thereof. The only payment which a grantee will have to make, on receiving his grant, will be eight annas an acre for the costs of survey and demarcation.

# SECTION THROUGH THE GREAT ORGAN AT THE CRYSTAL PALACE.

MESSRS. GRAY AND DAVISON, BUILDERS, EUSTON ROAD, LONDON.

*For description see page* 393.)



FOREIGN AGENTS FOR THE SALE OF THE ENGINEER.

PARIS.—Madame BOYVEAU, *Rue de la Banque.*
BERLIN.—ASHER and Co., 5, *Unter den Linden.*
VIENNA.—Messrs. GEROLD and Co., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—THE WILLMER and ROGERS NEWS COMPANY, 31, *Beekman-street.*

## 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.*

W. M.—*Your digging machine is very old in principle, and will not work.*

A. G. H.—*Mr. Davis, Office of the Naval and Submarine Exhibition,* 4, *Westminster-chambers, can supply you with the information about diving which you seek.*

KINGSBRIDGE.—*Your first set of questions we published last week in our "Miscellanea" column. None of the designs you send us for dynamos are new, save* X3, *which would not produce any current. All the others are embodied in whole or in part in the machines of Burgin, Brush, Gramme, Siemens, &c.*

J. E.—*The greatest speed attained by large torpedo engines is about* 620 *revolutions per minute;* 450 *is not an unusual speed. Messrs. Gwynne, of Hammersmith, have run small engines up to* 1400 *revolutions, and we believe Hodgson's rotary engines at the Crystal Palace have made* 1500 *revolutions unloaded.*

HENRY.—*The bolts will carry the weight. We cannot see that expansion of the tube will in any way affect the strains, except that by a slight increase in the circumferential length of the tube, it will take a position on each bracket a little farther from the column, and so will slightly increase the leverage on the brackets and bolts, but to a very small extent.*

HORSE-POWER.—*It is very unwise to expect a condenser to lift its own water any height. In practice, however, it is not unusual to make condensers lift water* 7*ft. or* 8*ft. If an engine runs for long periods, however, a condenser may be made to lift water* 14*ft. or* 15*ft., and not to give trouble, but in such a case special arrangements must be made for obtaining a vacuum to begin with.*

L. C. C.—*We do not quite understand your question concerning the limits within which injectors will act. If you will state it definitely, we shall be happy to answer it. The power of an injector either to lift or force water depends on its construction. Thus there are injectors in the market which will lift water over* 20*ft., while there are others which will not lift it* 2*ft., but the latter are, under proper conditions, as useful as the former.*

### SHELLAC MACHINERY.

(*To the Editor of The Engineer.*)

SIR,—Will any of your readers kindly inform us who are the makers of machinery and plant for shellac and varnish? M. AND T.

London, June 1st.

### COMMON ROAD STEAM CARRIAGES.

(*To the Editor of The Engineer.*)

SIR,—I shall be much obliged if any of the readers of THE ENGINEER will tell me where I can obtain a light road engine, to work by steam or otherwise, and able to carry one or two persons. I am aware that a convenient engine for this purpose was brought out some years ago, but have been unable to obtain the name of the maker. E. S. A. B.

Kensington, May 30th.

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### MEETING NEXT WEEK.

SOCIETY OF ENGINEERS.—Monday, June 5th, at 7.30 p.m., a paper will be read "On Railway Tunnelling in Japan" by Mr. T. M. Rymer-Jones, the leading features of which are as follows:—The Osakayama Tunnel—gradients—gauge of railway—geological features—setting out the work—driving the headings—formation of arch—centreing—construction of tunnel—absence of shafts—description of pumps and drainage—ventilation—detail of cost—general remarks on tunnelling—other tunnels—advantage of compressed air in rock-boring machines—Jordan's hand rock drills—use of electricity as a motor and for lighting purposes—general conclusions.

# THE ENGINEER.

*JUNE* 2, 1882.

### STEEL FOR STRUCTURES.

ENGINEERS when preparing designs for roofs, bridges, and indeed all kinds of metallic structures, no longer fear to use steel. It is probable that the worst is known concerning it; indeed, Sir Henry Bessemer's noteworthy statements on this point will not soon be forgotten, and this being the case, it is now employed with a daily increasing freedom. But there is good reason to think that it is being used without due discretion; in some cases without sufficient caution, and others with too much; and it seems that the time has arrived when engineers will do well to consider in what direction they are going, and whether their present practice in connection with steel does or does not need revision. In steel, when properly made, and of a scantling not too large, we have a material which can be made to vary in its characteristics through a comparatively wide range. For the moment we shall shut out all reference to the hard tool steels, and confine our attention to the softer steels, which take the shape of bars, plates, rods, and angles. Now such steels can be had with a breaking strength varying between 28 tons and 45 tons to the square inch, and an elongation varying between 25 per cent. and 5 per cent., while the limit of elasticity is anything but narrow. In practice engineers usually specify for a steel with about 30 to 31 tons tensile strength, and an elongation of 15 to 18 per cent., and they do this without any regard for the uses to which the metal is to be put. They in no wise avail themselves of the enormous difference which can exist between various kinds of steel, and thus bring the whole produce of the steel makers of the world down to a dead level of uniformity. We think it can be shown that this is bad policy, and that it would be far better to specify in every case for that type of steel which will best suit the purpose of the design of the structure in which the steel is to be employed.

So far as the civil engineer is concerned, there are only two principal conditions under which steel or iron is used. It may be exposed to a quiescent, or statical, load, or it may be submitted to rapidly recurrent dynamical strains. Thus in a roof the strain will be always statical, unless it can be said that a high wind may now and then produce dynamical strains. But in a railway bridge the strains are not only statical, as in the case of a roof, but dynamical as well, every train which passes putting the whole bridge into motion. The paths described by the various portions of the bridge are involved to a degree. An American engineer has recently carried out some experiments with a very simple apparatus, by which a bridge is made to register its movements automatically when a train passes, and this apparatus shows that the bridge not only moves up and down, but that as a train enters upon a girder, the whole girder is moved forwards and returns again as the train leaves it. All the excursions of the various portions of the bridge have small linear values, but they are none the less real; and when we find a joint or a bar moving through a distance of even one-eighth of an inch only, we are fully justified in regarding the strain produced as dynamical, and the bridge does work, which is more than can be said of the roof, let us say, of the Midland terminus at St. Pancras. Now it seems to be clear that a steel which will do very well for a roof is not the steel which will do for a bridge. If we take a steel capable of standing 45 tons to the square inch, and loaded with a static strain of 15 tons to the square inch, it should be quite safe in the form of a roof, but it would not perhaps be safe in a bridge. In this last, a 32-ton steel, loaded to 10 tons on the square inch, ought to be perfectly safe, provided proper care is used in the manufacture of the metal. We should not have the least hesitation in using a hard strong steel in a roof, while in a bridge nothing would induce us to employ anything but a ductile, and therefore a soft steel. Each is right in its own place. But to limit the engineer to the use of a low steel in a roof is simply to deprive him of one-half the advantages which the new material can confer upon him.

It may be urged that it can never be safe to use a metal with but 5 per cent. or so of elongation. We confess we do not see the force of this assertion. The steel tie-bar of a roof is never called upon to elongate, and no amount of stretching of which it is capable would save the roof if its destruction were imminent. Let us take, for example, a roof with the comparatively moderate span of 100ft. Let us suppose that the tie-rods coupling the feet of the principals is also about 100ft. long, and that it is of very mild steel. The initial load is, say, 7½ tons on the square inch; the limit of elasticity will be about 15 or 16 tons, probably less; the extension is 25 per cent. In other words, the bar is supposed to be capable of stretching 25ft. before it will break. But is it not clear that if it stretched even one foot the side walls of the building would be driven outwards, and the ruin of the structure would be almost as complete as though it fell down bodily? Of course we shall be told that the ductility of the metal is never expected to come into play, but that its presence affords evidence that the metal is not brittle. But we reply that an extension of but 5 per cent., *when taken with other characteristics of the steel*, supplies ample evidence that the metal is ductile enough for the intended purpose. And it will not be found easy to maintain that a roof, the breaking strength of the tie-rods of which is 45 tons to the square inch, is weaker than another roof the tie-rods of which can stand but 31 tons to the square inch. The actual strain to be brought on in either case must be a direct tensile strain, and neither the one material nor the other can be called brittle, or be said to be incapable of bearing such shocks or strains as a roof may be submitted to. Even when we come to speak of bridges, it is by no means as clear as some persons would have us suppose, that the low steel must be much superior to the high steel. There is in existence an abundance of iron bridges the metal in which would not give an extension of 5 per cent., but no one appears to think that they are anything but perfectly safe. Hundreds of boilers are made year after year, the power of extension in the plates of which is practically nothing—1 or 2 per cent. perhaps, yet these boilers while new never explode. But metal of this kind worked up into a piston rod for a steam hammer would probably not last two hours. The difference in absolute strength between a low and a high steel is so great that much may be said in favour of the latter so long as it retains a useful amount of ductility. It is well known that if the engineer will rest content with a comparatively small range of extension before fracture, the steel maker can supply a tremendously strong material at a moderate price. This being so, it will be seen that there are comparatively boundless opportunities at the disposal of the engineer for producing roofs of large span. There ought to be no risk whatever in loading such steel as we have in our minds up to 15 tons on the inch static load, and a very few calculations will show that it is practicable under such conditions to make roofs of small or moderate span at very moderate cost indeed; while, on the other hand, roofs of gigantic dimensions become possible. It must not be forgotten, however, that in dealing with steel of small scantling, nothing but first-rate workmanship will suffice. Everything intended to bear a tensile strain only must be kept quite free from all other strains. Pins and joints must not only be of ample size but very carefully fitted; and as there will be a small margin—by comparison with some iron structures—for corrosion, great pains should be taken with the painting, and the design should be of such a character that every portion may be accessible to the painter's brush.

We need hardly add that all we have said is based on the assumption that the steel is what it pretends to be, namely, of first-rate quality throughout. Nor is it to be supposed that the figures we have given, such as 45 tons to the square inch, 15 tons, and 5 per cent., are more than illustrative. They serve to attach definite ideas to the words we use, that is all. Our contention is that as innumerable qualities of good steels are in the market, the engineer should vary his practice by availing himself of the opportunities which the steel makers afford him. He now uses precisely the same type of steel in a roof that a mechanical engineer would put into a crank shaft or a steam hammer piston rod, and by doing this he throws away great opportunities. The Board of Trade have at last consented to the putting of strains of 6½ tons per square inch on steel in bridges. We hope to see the limit raised ere long to 10 tons. If 10 tons are safe in a bridge, 12 or 14 tons are safe in a roof. The only plea that can be urged against this is that the wind puts on heavy strains. But we have yet to learn that those strains are other than those conditioned by elastic pressure; and if this is so they need cause no alarm. They have nothing in common with those set up in a bridge by the pounding of a heavy locomotive over the rail joints on a bad bit of permanent way.

### THE MORALITY OF BOILER INSURANCE.

THE inquest on the Radcliffe boiler explosion, particulars of which we published last week, brings again to the front an accusation which has frequently been made against boiler insurance associations working for profit, namely, that their system is directly conducive to accident. This notion appears to be persistently advocated, if it was not actually originated, by Mr. Fletcher, the chief engineer of the Manchester Steam Users' Association, which, although comparatively unimportant in regard to its actual operations in boiler inspection, is the oldest of these inspection societies, and claims pre-eminence in point of respectability from the fact that the profits of the undertaking are not divided among shareholders, or even among its members—as in the mutual boiler insurance companies—but are devoted to the establishment of a reserve fund, the increase of the salaries of the officials, occasional experiments, and the dissemination of reports. The value attached to the system by steam users may be gauged by unprejudiced observers from the fact that while some 4000 boilers are under Mr. Fletcher's supervision, ten times that number are insured by the joint stock companies, one company alone having 20,000 boilers on its books. The idea we have referred to has, however, been adopted in some quarters, and is systematically advanced when an insured boiler explodes. In connection with the Radcliffe explosion a contemporary, for example, trotted out this pet theory last week, notwithstanding the fact that the counsel engaged at the inquest for the owners of the boiler, signally failed to establish, to the satisfaction of the jury, the applicability of the theory in this instance. The jury, after a patient and exhaustive inquiry extending over three days, while returning a verdict of accidental death, blamed the manager of the works, as he had not given the insurance company reasonable facilities for the examination of the boiler, a fact which it is suggestive to note our contemporary carefully suppresses, while professing to lay the matter in its entirety before his readers for their impartial judgment in apportioning blame.

We may say at once that, after consideration of the whole of the facts, we entirely agree with the jury. The immediate cause of the accident was quite clear. It was due to external corrosion of the shell in the side flue, one length of plate above the seating having wasted until there was not sound metal enough left to stand the pressure of the steam. It was impossible to say how long very active corrosion had been going on, but it was generally conceded that in all probability an examination by a competent inspector any time within the past twelve months, and certainly within the past six months, would have revealed the defects and prevented the explosion. As will be seen on reference to our notice of the accident last week, the last examination of the boiler in the flues by the insurance company was made on 5th January, 1880, when portions of the plate were found to be corroding where in contact with the seating, which was damp. The attention of the owners was directed to this, and they were recommended to take efficient means for the prevention of the dampness. No direct evidence that any attention at all was paid by the firm to this recommendation was tendered at the inquest; but from the fact that leakage from a cold-water pipe passing through the flues at the back of the boiler was discovered and stopped, and that no further reference to the dampness was made in the subsequent reports of the insurance inspector who visited the works about every three months, obtaining such information as he was able with the boiler under steam, the probability that they did not entirely disregard it may be placed to their credit. The suspicion of the insurance company's representatives as to continued neglect of the boiler and seatings appears at all events to have been allayed, but as a measure of precaution the attention of the firm was frequently directed—six times in all since January, 1880—to the importance of having the boiler examined externally and in the flues. Two special communications were sent, one of them having been forwarded ten months before the explosion, pressing for an "early" opportunity to make such an examination, and the firm were told that until this was carried out it was impossible to furnish them with information as to the

condition of the boiler. The Christmas of 1880, and the Whitsuntide of 1881, together with any local holidays and other occasions which no doubt afforded opportunities for cleaning out the boiler were entirely disregarded, and it was not until Saturday, the 31st of December last, that the firm sent to the insurance company a notice, which was practically no notice at all, that they might examine the boiler on the following Tuesday. Owing to Sunday and the Monday, which was kept as a holiday, intervening, the notice was not received until the day when the examination was to be made, and from the pressure of work at the moment, it was found impossible to send an inspector in time. Had the firm under these circumstances taken the not very extraordinary course of spending a few shillings in the engagement of an ordinary boiler maker to examine the boiler before starting again, the accident would in all probability have been prevented. Nothing of the kind, however, was done, and notwithstanding a subsequent pressing request from the insurance company for an opportunity to examine the boiler, it was worked on until it exploded on the 1st ult. These facts were proved in open court and are beyond dispute, and to any ordinary mind it would appear that so far from deserving censure the insurance company really deserves credit for the pains they took to keep the boiler-owner out of danger.

Now, we hold that the continuance of the insurance where the owner was informed in the plainest possible language that the insurance company could give him no information as to the condition of his boiler, pressing him at the same time for an opportunity to examine it, could no more conduce to the neglect of his boiler than the granting of a policy on his life would make him negligent of the ordinary means of preserving his own existence, presuming him to be ordinarily sane. It is amazing to find a reply by the manager of the works to a question put by a juryman put forward in support of a contrary notion. "What," asked the juryman, "would you have done had the insurance company threatened to cancel the insurance if you did not grant an opportunity for a thorough examination of the boiler?" "I would have got it ready at once" was the reply. None but a child would expect any other reply from a man after the explosion, and with a verdict of manslaughter possibly hanging over him. A better judgment of what he would have done under such circumstances can be found by looking at what was actually done. Turning to the evidence, we find that the boiler was insured for only £100, and on being asked by the Board of Trade officer present why it was insured for so small an amount, the manager replied, "The object sought was merely to have it examined and to remove the responsibility from their shoulders on to the insurance company." Letters put in by the firm themselves showed that prior to 1878 the boiler was allowed to work for eleven years without a thorough examination. From the evidence produced at the inquest it appears that this would certainly not now be tolerated by the insurance company under its present management; but what can be said of a firm who avowedly insured for the sake of inspection and allowed the boiler to go eleven years without it? Would they have taken greater care had the mysterious influence attributed by a contemporary to the £100 insurance been withdrawn, and the insurance company had been merely engaged to inspect the boiler? A case which occurred the year before last furnishes a reply. A boiler exploded from simple corrosion of the shell at Ruabon, and ordinarily careful inspection would have discovered the defect. Six people were killed, and thirteen others were seriously injured. The boiler had been for nine years under the supervision of the Midland Boiler Insurance Company, which had a contract for its inspection without insurance. The owners here had allowed the boiler to work for the last five years of its existence without a thorough examination being made by the Boiler Insurance Company, which was willing and anxious to carry out its contract. Plainly the fact is that there is a class of steam users who will not take ordinary care of their boilers unless compelled to do so by law, and it is matter of surprise to us, looking at the very considerable proportion of this class of accidents that occur, that explosions among insured boilers should be so few.

### LEICESTER FLOOD WORKS.

The opening of the Abbey Park by their Royal Highnesses the Prince and Princess of Wales on Whitsun Monday last may practically be considered as the opening of the first section of the important engineering works which have been in progress for the last three years, for the prevention of floods in the borough of Leicester. From an early period the river Soar has been formed into a series of ponds for the purposes of mill power, there being seventeen mills on the Soar from its source to the junction with the river Trent, a length of about forty miles. Some of these ponds have been rendered navigable by the construction of canal locks, the lifts being adapted to the ancient fall of the respective mills. The area drained by the Soar above Leicester is about 90,000 acres, the distance of the limit of the watershed being about fifteen miles from, and at an elevation of about 300ft. above, the Soar at Leicester, and in periods of heavy rainfall floods rapidly accumulate and discharge through the borough at a very considerable velocity, the volume of water sometimes amounting to as much as 400,000 cubic feet per minute. The discharge obstructed by artificial dams, canal embankments, contracted weirs and bridges, overflows the banks of the adjoining lands down the valley, which is comparatively level and from 800ft. to 2000ft. in breadth. The inhabitants of the low-lying thickly populated districts have been very seriously, and frequently, sufferers from the flooding of the streets and houses at times to the depth of 4ft. to 5ft., and to prevent the occurrence of such serious and disastrous floods was a subject which has engaged the attention of the Town Council and the inhabitants of Leicester for very many years. The advice and assistance of the most eminent engineers was obtained, and eventually works embracing the purchase of the water right of mills, the straightening, widening, and deepening of the river, the removal of old weirs and obstructions to the free flow of the flood waters, have been completed, and have drained the site of the Abbey Park so as to admit of a beautiful pleasure ground being formed on what was formerly a swamp. There is no doubt that when the works in the western part of the town are completed, Leicester will be permanently relieved from a serious periodical grievance. The section of the works for the prevention of floods was most severely tested by the extraordinary flood in July, 1880; when the flood water was several feet deep in the western part of the town streets, while the site of the works and the Abbey Park were absolutely free from flood. Still below Leicester there were about 11,000 acres in the Soar Valley immersed in water to the depth of several feet; and in order that this valley may be permanently relieved it is very necessary that works similar to those executed by the Corporation of Leicester should be continued down to the Trent, a distance of about twenty-two miles. The river works were executed by Messrs. Benton and Woodiwiss, of Derby; the canal works, by Messrs. Whittaker Brothers, of Leeds; the park works, by Messrs. Barrow, Son, of Elvaston, landscape gardeners, the engineer being Mr. F. Griffith, C.E., the engineer of flood works to the Corporation; and the total cost of the works was about £150,000, which includes £25,000 expended upon the formation of the park and the purchase of land and the abolition of the right to water for the purposes of power.

### THE NORTHERN CHEMICAL TRADE.

The condition of the chemical trade of the North of England, owing to the adoption of various new processes in other districts, is at the present time one that is most discouraging. The process almost universally adopted in the North of England is that of Leblanc, and the development of the ammonia process has so increased the production of alkali and certain classes of chemicals that for several years prices have been falling, and it is stated that few if any of the chemical works on the Tyne have been making a profit for a considerable period, whilst in several instances a loss has been actually incurred in carrying on the works. Nor is the future more promising, for the over production which is taking place is likely, it is feared, to bring down prices to a still more unprofitable level. Various suggestions have been made to meet the difficulty—reduction of the output and the obtaining of the raw materials at less cost. An attempt to induce a restriction of the output a little while ago failed, and though it is possible that it will be renewed, it is not expected to yield much result. The two chief raw materials that reduced prices are possible in, are sulphur and salt. The former is a monopoly, in the hands of three great companies who import it, and though it is known that one of the three is favourable to a reduction, and that to a substantial amount, it is scarcely anticipated that the others will join in such a movement, which needs the consent of the whole. From the present source of the supply of salt, little relief can be hoped—that supply coming from Cheshire and Durham—but the utilisation of the salt deposits of the south-east of Durham are expected to give to the producers of chemicals on the Tyne a much cheaper supply, the saving in the cost of railway carriage alone being very considerable. Unless relief from this source can be obtained, the only course for the Tyne makers to take will, it is urged, be that of restriction of the output—either by a combination of the makers in the district, or by the longer process of the survival of the fittest. It remains to be seen which course will be ultimately adopted, but it cannot be concealed that the present position of the chemical trade of the Tyne is critical.

## LITERATURE.

*On Vibratory Motion and Sound.* By Professor J. D. Everett, F.R.S. (Longmans.) 1882.

The publication of this excellent treatise comes very opportunely just at the moment when the experiments of Bjerkness and Stroh have drawn special attention to the phenomena of vibrations, whether in water or air; and to all those who, being interested in those experiments, wish to follow out the ideas which they suggest, we commend the perusal of this book. The theory of vibratory or undulatory motion is generally studied in connection with some special subject, usually sound or light, and is also connected with very high mathematics, which make it alarming to the ordinary reader. The theory is, however, quite capable of being studied by all who have mastered the elements of dynamics—the class for whom Professor Everett has specially written his treatise. We believe there are many engineers who fulfil this requirement, but who yet have very indistinct and imperfect ideas as to the real nature and properties of an undulation. This arises in part from the way in which the subject is presented, when in a popular form. We are almost always bidden to drop a stone into still water, to watch the wavelets which spring up around the spot of its fall, and swim away in ever-widening circles till they are broken up and lost; and from this to construct our ideas of the wave motion to which sound and light are alike said to be due. But while there is of course some likeness between the wavelet on the pond and the undulation in the air or the ether, the differences between them are too large to be neglected even for a moment. The wavelet is in two dimensions only—that is, it is propagated along the level surface of the water: the undulation spreads out in all directions from the centre of disturbance—unless where the elastic medium is cut off by some solid body—its shape at any instant being thus a sphere instead of a circle. The wavelet is shattered and dissipated to nothing the moment it strikes the shore: if the undulation meets a solid body it divides into two parts, one of which is reflected back from the surface and returns whither it came, while the other passes on with more or less modification into the interior of the body. The wavelet starts with a comparatively high and steep crest, which rapidly dwindles down as the circle expands, till it melts into the still surface of the pool. The undulation travels at a speed which is almost immeasurably greater, and to a distance which, if its action be free, knows apparently no bound. Lastly, the path of each atom of water, as the wavelet passes through it, is a vertical rise and fall—in other words, its direction is transverse to the direction in which the wave itself is propagated. The same is held to be true of those ethereal undulations which make up heat and light, although the exact direction of their motion is yet a doubtful problem; but in the case of sound it is certainly different. There the particles of air behave like those of india-rubber in a buffer or draw spring. They are first forcibly driven or compressed together, and then spring back again, by their own elasticity, to a point beyond their original position of rest. A better notion of the facts will, perhaps, be gained by imagining that we have a series of thin india-rubber balls, enclosed concentrically one within the other, and that a pinch of gunpowder is fired at the centre. Clearly the first effect will be that the innermost ball will expand outwards in all directions, each point on the surface moving along the radius of the sphere; when the force of the explosion is expended, the sphere will contract again as suddenly as it expanded, oscillating inwards and outwards alternately, until it comes to rest. Meanwhile, the second ball will have been pushed outwards by the expansion of the first, and in an exactly similar manner; it will have acted in its turn upon the third, and will itself have contracted again by its own elasticity. Thus a wave, so to speak, of alternate expansion and contraction will run through the series, the distance between each pair of balls being first lessened and then increased again, and thus forming a condensation, followed by a rarefaction. If we now suppose the balls to lose their solidity, though not their elasticity, and to become mere contiguous films of air, we have here the whole phenomena of a wave of sound. A wave of light or heat cannot be so simply represented, because, as we have said, the vibration of each point on the surface will be at right angles to the radius, and not along it. In our ignorance of the exact nature of these vibrations, any new physical illustration might possibly lead astray almost as much as the old one of a pond wavelet appears to have done.

It may be objected, perhaps, that if the exact form of the ether undulations be thus unknown, it must be impossible to examine them scientifically or draw any valid conclusions concerning them. To any one who makes this objection we should advise the study of Professor Everett's book. Not that he will there find any precise discussion of the vibrations in the case of the ether, which forms no part of the plan; but, besides obtaining a correct idea of the difference between longitudinal and transverse vibrations, he will see how the motion of any vibrating particle, whether that motion be of the one class or the other, may always be expressed by a simple trigonometrical formula, the only condition being that the motion is so small as to make the law of the elastic force expressible with sufficient accuracy by the well-known formula called Hooke's Law. In other words, the force tending to restore the particle to its original position of equilibrium must be supposed to vary as the distance through which it has moved from that position. If this distance—or the amplitude of the vibrations, as it is called—be sufficiently small, this may be assumed to hold, whatever the actual law of force may be; and then the motion can readily be shown to possess a certain definite character, to which the name of simple harmonic motion has been given.

The principal object of Professor Everett's book is to set forth the theory of this motion in its various ramifications; and this is done in a very clear and masterly manner, chiefly by simple geometrical methods. The book, however, is by no means one of theory alone. Thus, as an illustration of the composition of harmonic motions, he describes the working of the familiar pantagraph—or, as we believe it should be written, the pentegraph, being essentially an arrangement of five linked points. Again, the similar composition of two harmonic motions is shown to account for the phenomena of what are called "beats" in music and of spring and neap tides; and later on the practical application of the latter fact is brought out by a description of the tide-predicting apparatus of Sir William Thomson and Mr. Roberts. A diagram shows a set of tides for the port of Beypore, as "ground out" by one of these instruments, belonging to the Indian Government. Other practical examples adduced to illustrate the theory of vibrations are the crank and connecting rod, the link reversing gear, and various contrivances for producing simple harmonic motion on a large scale, such as Donkin's harmonograph, and an elegant adaptation of the pantagraph invented by the author.

One point may be referred to in conclusion, which is sometimes a difficulty to the student, namely, the energy exerted in producing the vibrations of sound. Assuming that a lark can be heard singing in the air at any distance up to a quarter of a mile, it is obvious that we have here a globe of air, half a mile in diameter, the whole of which is thrown into agitation by the effect of the bird's voice. It may well seem that this is almost incredible. But an investigation into the case shows that the energy expended in producing any particular vibration varies as the square of the amplitude—that is, the distance through which the particle swings; and as in the case of sound this distance is excessively minute, it follows that the energy required is excessively minute also. It must be remembered that one original exertion of energy by the bird serves to produce vibration in all the concentric shells of the supposed globe, one after another; and also that the friction in the case of longitudinal vibrations, such as those of sound, is probably *nil*, the particles approaching to and receding from each other without any action of the character of shearing taking place. To all those interested in this question, or any others relating to vibratory motion, we can with confidence recommend the study of Professor Everett's elegant and masterly treatise.

## THE ST. GOTHARD RAILWAY.

The railway passage of the Alps from Switzerland to Italy is at last an accomplished fact, and in a few days express trains will be running from Calais *viâ* Rheims and Bâle to Milan, without change of carriages. Already the representatives of Italy have passed through the tunnel northwards, have been received with banquets and festivities at Lucerne, and have carried their Swiss friends back with them to enjoy similar welcome at Milan. It is true, as our readers will remember, that this ceremony in no sense celebrates the completion of the great tunnel, which was opened for local traffic some time back. Nor does it assure the complete and enduring success of the

project, at any rate from a commercial point of view. There are questions yet to be solved, such as the keeping open of the approaches on both sides throughout the winter, the regular working of the traffic over the steep inclines and curves, especially within the "screw tunnels" which have been used to facilitate the ascent of the mountains, and last, but not least, the ventilation of the great tunnel itself. As to this last, we have the assurance of our correspondent who traversed it a few days before the opening, that the air within was at that time very fair; but it is still doubtful how far this will be true when the increased service of trains comes into play. This matter, however, we have dealt with only recently. Meanwhile the opening of the line throughout is at least a very definite step in its progress, and renders this a fitting opportunity to put before our readers a brief sketch of this great engineering work.

The idea of a railway between Switzerland and Italy appears to date back as far as 1840, but it was first put into a practical form in 1865, when the Italian Government appointed a commission to study the question. This commission reported in favour of the St. Gothard as against the two competing routes of the Splügen and the Fuhmanier, both as regarded the conveyance of local traffic from one side of the Alps to the other, and through traffic from the North of Europe to India and the East. Their report decided the Italians, and eventually the Germans and Swiss also, in favour of this route; and at last, in October, 1869, a scheme for the building and working of a St. Gothard Railway was agreed upon, in a conference at Berne, between representatives of Italy, Switzerland, North Germany, Baden, and Wurtemburg. Two years more of negotiations elapsed before the St. Gothard Railway Company was formally constituted and began to work. The great tunnel, the especial feature of the scheme, was begun in June, 1872, and was completed, after 9½ years ceaseless labour, towards the end of last year, being opened for traffic on 1st January, 1882. The works of this tunnel, which have been often described, will not be touched upon in the present article.

The valley of the Reuss, up which the railway passes from Fluelen to the tunnel, rises by rapid steps from the level of the Lake of Lucerne, with more level stretches between. The original project was to surmount these steps by inclined planes worked on some special system, and to have a comparatively short tunnel near the top of the pass. But it was soon recognised that neither time nor money would be saved by this latter plan. It was necessary to provide at each end of the tunnel for what is called the "Installation," that is, the dwellings of the workmen—3000 to 4000 in number—the buildings for engines and other motors, for workshops, stores, and offices of all kinds. To build these in the desolate regions of the higher Alps would be enormously expensive; and during the winter it would be difficult or impossible to find water for the supply of the engines. The rigorous climate would further increase greatly the difficulty and expense of keeping the men at work. For such reasons a long tunnel without shafts was decided on. At the same time the maximum gradient was fixed at 2·6 per cent.—about 1 in 40—and the idea of employing any special mode of traction, such as that of Fell, Agudio, or Riggenbach, was rejected, unless for temporary purposes. As early as 1850 a line between Göschenen and Airolo was laid out on paper and discussed by a Swiss engineer, Herr Müller. This idea was subsequently taken up and worked out more fully, in 1864, by two engineers of Baden, Beck and Gerwig, and was finally adopted in the international scheme above mentioned. Gerwig was for four years engineer of the line, during which time a careful survey was prepared on a scale of 1 to 5000 on the northern side, and 1 to 2500 on the southern, and a trace of the railway laid out upon it. His successor, an engineer from North Germany named Hellwug, had this trace marked out upon the actual ground; a footway was constructed along it, wherever possible, and cross sections, to a scale of 1 to 100, were taken at intervals. But this trace, which was mainly carried along the face of the precipices on one side of the valley at a height of about 300ft. above the road, proved to present such formidable difficulties of construction that Hellwug resolved to abandon it, and to adopt the principle of utilising every favourable stretch of ground at the bottom, on whichever side of the stream it might lie, thus obtaining the advantages of vicinity to the road, and avoiding of torrents, falls of stones, &c. Where the gradient would become too steep to allow this course to be followed he had recourse—as his predecessors had also proposed—to artificial lengthening of the line by means of curved tunnels pierced in the walls of the valley. In 1876 he published in German, French, and Italian a report embodying these proposals, and tracing out a route which, with small exceptions, has been actually adhered to. It will be seen, however, how much this preliminary work, which might well have been gone through earlier, delayed the actual construction of the line, and produced the vexatious and extraordinary result that the great tunnel, the *magnum opus* of the undertaking, was complete and open for traffic long before the approaches to it were ready. When Hellwug set fairly to work in 1876, the whole task of connecting the northern end of the tunnel at Göschenen with the Lake of Lucerne, and the southern end at Airolo with Biasca, in the Ticino Valley, had still to be done. Looking first to the northern slope, the worst portion was that from Göschenen to Silenen, where the line had to fall about 600 metres in 18 kilos., giving an average inclination of 1 in 30. As the maximum admissible gradient was 1 in 40, a lengthening of about 6½ kilos. was necessary; and no lateral valleys offered themselves, as in a like case on the Brenner, by which this could be cheaply effected. The lengthening must be done within the valley itself. Now this valley, between Göschenen and Fluelen, has four principal divisions. The first, from Göschenen to Pfaffensprung, has an average fall of 5·7 per cent., and is 6 kilos. long. It extends through the well-known gorge of the Devil's Bridge; and from the great height of the crags on each side its climate is unusually severe, and avalanches have to be provided against. The second division, from Pfaffensprung to Meitschlingen, is about 5 kilos. long, and is very steep in the upper part—where the Reuss makes two cataracts—but comparatively level in the lower. The rocks are lower, but more treacherous, the granite being richer in mica, and on the east side the fall of stones is a serious danger. The third division, reaching to the mouth of the Maderaven Thal at Amsteg, is 4 kilos. long, having a fall of 7¾ per cent. in the upper part, and only 1·8 in the lower. The course of the river is in a narrow winding cleft between steep precipices, and it is exposed to dangerous avalanches from the Bristenstock, which rises straight out of the valley on the eastern side. The fourth division, from Amsteg to Fluelen, is 17 kilos. long, and has a fall varying from ·8 to ·1 per cent. The width of the valley is also much greater, and the difficulties are trifling in comparison.

Looking at these natural features, Gerwig had proposed to begin the incline far down in this last division—9½ kilos. north of Fluelen—so as to have attained a considerable altitude by the time the more difficult part was reached. This, however, involved very lofty viaducts over the lateral valleys, and other difficulties. Hellwug started the mountain part of his own line 2½ kilos. higher up, keeping it 20m. to 30m. lower throughout, and so getting easier viaducts and better foundations.

In the next division he abandoned the right bank—where Gerwig's trace had lain—on account of the dangerous proximity of the Bristenstock, and chose the left, where the ground lies more in terraces, so shielding the line from avalanches. By this route he reduced the length in tunnel by more than two-thirds as compared with the former project; but as he reached Pfaffenspung at a level about 50m. lower, it was necessary to make good this extra rise, and this he accomplished by a spiral tunnel at that place about one mile in length. Having thus reached the level of his predecessor's trace, he followed it pretty closely to Wattingen, keeping, however, a rise of 1 in 40, while that of the valley bed is about 1 in 18. Consequently at the latter place there are still 220m. left to rise before the level of Göschenen can be attained; and for this, at 1 in 40, 9 kilos. length is necessary, while the valley itself allows 4 kilos. only. The extra distance is obtained—following Gerwig's design—by a long double zigzag, having the station of Wasen in the middle of it in a very convenient position. This zigzag passes over an ancient "Berg-fall," and presented extreme difficulties of construction; but no other expedient has presented itself.

Let us now suppose ourselves to have attained by this means the level of Göschenen, to have traversed the great tunnel, and to be considering how to effect a descent on the southern or Italian side. From Airolo to Biasca there is a total fall of 849m. in a length of 36 kilos. These conditions appear much more favourable than on the northern side, as the length is sufficient to allow a uniform gradient of less than 1 in 40. Such a line was actually laid out by Gerwig; but its construction proved to be impracticable, owing to the abrupt steps by which the total fall of the valley is accomplished. Here, again, four stages may be reckoned. The uppermost—from Airolo to Stalvedro—is only 1 kilo. long, and has a very moderate fall. On the left bank are terraces, which allow an easy course for the line. In the next—Stalvedro to Dazio—the valley narrows to a ravine, and there is considerable danger from falling rocks, especially where several lateral torrents debouch into the valley, generally almost dry, but in flood time sweeping down vast masses of *débris*. In the beginning of the third division—Dazio to Giornico—the Ticino falls headlong, chiefly in a narrow gorge, from one level to another, descending no less than 114m. in the first 1·25 kilos. From thenceforward the slope is less, but, especially on the left bank, several lateral torrents descend steeply into the main valley. In the last division—Giornico to Biasca—the river again has a fall of about 1 in 10 for 1 kilo., and then enters a gorge 3 kilos. long, where it has a fall of about 1 in 70. For the remaining 6 kilos. the course is easier. There are several lateral valleys and torrents, which bring great quantities of rubbish into the main valley, often invading the chesnut woods and vineyards, and doing much damage. This is especially the case on the right bank, where there are also continuous precipices of gneiss, making the construction of the railway here—as originally intended—quite impracticable. Here, however, it must have gone, if a regular gradient from Biasca to Airolo was to be observed. Gerwig proposed to overcome the difficulty by starting the 1 in 40 gradient 4½ kilos. above Biasca, and making it take a long return zigzag, giving it height enough to attain the level of Dazio without any further change. But this line entailed the passing of Giornico at a vast height—over 500ft.—above the valley, and the traversing a most dangerous piece of ground at the left bank between Dazio and Faido, where the rocks are so cleft and faulted that the torrents are swallowed up altogether, and only reappear in the bed of the Ticino. In seeking a mode of escape, it was found that the gorge at Dazio could easily be crossed by a bridge of only 80ft. span, and that the ground on the right bank as far as Faido was not impassible. Here, however, the right bank becomes impracticable, and it is absolutely necessary to re-cross the river, which at this point would be some 350ft. below the line. Happily the ground permits of the line describing a circle, of which, however, about 1500 yards would be in tunnel, and it then comes back to the river some 150ft. below its former level. By this means the main danger of the original route might have been avoided, but the detailed plans and estimates showed so very unfavourably, that it was finally resolved to follow the same principle as on the northern side, namely, to keep as closely as possible to the bottom of the valley, and to surmount the two steps at Dazio and Giornico by spiral tunnels. Hence the downward course of the line, as actually constructed, is as follows:—The incline begins immediately on leaving the station at Airolo, and the right bank of the river is followed to Fiesso, from whence the decline of 1 in 40 is continuous. Here the railway crosses to the left bank by a bridge 60m. wide, and approaches the top of the Dazio Gorge at a height of only 15ft. above the stream. Passing this, and a tunnel 500m. long, it re-appears, now at a height of 150ft. above the river, and then begins a complete circle of 300m. radius, of which about 260 deg. is described within the bowels of the mountain. The length of this spiral tunnel is 1567m., and it has a fall of 2·3 per cent., or 1 in 44. The line emerges at a height of 30ft. above the river, which it then crosses to the right bank, attaining a kind of terrace, which it follows for 1½ kilos. further. By this time the river, in its continual fall, has reached a level about 250ft. below the line; and to make this up another spiral is necessary, having a radius partly of 300 and partly of 400m., and comprising a tunnel of 1560m. in length. Below this the line crosses the valley by an embankment 200m. long and 80ft. high, with a bridge over the Ticino of about 230ft. span. The comparatively easy ground on the left bank is now reached, but several débris-carrying torrents have here to be bridged, and one—that of the Nadroberg—carried over the line by an aqueduct 50ft. span. Sweeping round the turn of Faido in a deep cutting, the line follows the course of the valley about midway between the post road and the side slopes of the mountain, to the station of Livergo, and for about 2 kilos. further. Here, however, the river, descending in a series of cascades, is already 300ft. below the railway, and fresh devices are necessary. The line first passes behind a specially dangerous torrent, La Lune, by a tunnel 466m. long, crosses another torrent, the Piano Tondo, by a viaduct of several spans, and comes upon the upper spiral tunnel, which bends through an angle of 280 deg., with a radius of 300m., and has a total length of 1568m. Emerging from thence it crosses the road, and then the Piano Tondo for the second time, and a little further, sweeps through the second spiral tunnel, also of 280 deg., and 1546m. in length. At its exit from this it once more crosses the Ticino by a bridge of about 220ft. span, and enters upon a gentle slope at the foot of the great moraines of the St. Peregrinsberg, over which it is carried for 3 kilos. without any serious difficulty. At the end of this it again crosses the Ticino by a bridge widened by flood openings, and follows the left bank to the station of Bodio, which may be considered as the foot of the great southern incline. A large stone embankment, to ward off any possible danger of the inception of floods from the violent torrent of the Vallone, is the last work of special character on the line, which thereafter runs by easy gradients to Biasca.

The above sketch will at least be enough to show the peculiar difficulties which had to be encountered in carrying a line over the St. Gothard pass. On the question whether the mode of overcoming them, proposed by Hellwug, and finally carried out, was really the best, there will naturally be much difference of opinion. On one point it is due to his memory—for his death has lately been announced—that a clear explanation should be given. It has sometimes been said that the fixing of 1 in 40 as the maximum gradient of the line was due to the initiative and influence of Hellwug. It appears, however, that this decision had been made by the International Conference some eight years before he took command of the works; and therefore he was only responsible for the mode of carrying it out. Whether it might have been possible to get the decision modified, when subsequent investigation had shown the enormous difficulties which it entailed, we are of course unable to say. In our own opinion it was at least a matter of deep regret that a rule laid down in 1869 should be rigidly adhered to ten years later, in spite of the enormous expense involved, and in spite of the fact that the art of overcoming steep gradients had made great progress in the interval. If there ever was a case when the haulage by ordinary locomotives, with its limiting gradient of 1 in 40, should have been departed from, and some special means of traction substituted, it was in this, where the bottom of the valley, or both sides of the chain, ascends as it were by steps, and where also the difficulties of a line winding up the sides of a mountain were insuperable. It cannot but be regarded as a disgrace to the engineering talent of the world that no means should have been forthcoming for hauling the traffic up these steps by a direct incline, say, of 1 in 10, and so avoiding the monstrous and barbarous expedient of driving spiral tunnels into the bowels of the earth for the mere purpose of reaching a different level. The first cost of such tunnels must of course be enormous, and their maintenance cannot but be attended with much difficulty and expense. The civil engineer may, of course, plead that no less costly way was open to him, so long as the 1 in 40 gradient remained imperative. We will grant for the moment that this was the case. If so, the blame must lie with the mechanical engineer, who was unable to furnish means by which steeper gradients might have been used without danger or inconvenience. For ourselves, however, we do not believe that this was so. A study of what has been done, more especially in the Alps, as to the construction and working of mountain railways, will show to any unprejudiced mind that there was more than one method in existence by which the difficulty might have been overcome. As a matter of fact, detailed projects were submitted, which would have reduced the cost of construction probably by one-third; but they were not listened to. The true cause must be found, we believe, in the timidity and love of routine which are characteristic of all who hold high official positions, and which are sure to be present in augmented strength whenever the work in hand partakes of an international character. Their baleful effects will be felt, probably for ever, by all those who are pecuniarily interested in the great undertaking we have endeavoured to describe.

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THE CLEATOR MOOR WATER SUPPLY.—After a considerable amount of agitation on the part of the inhabitants at Cleator Moor, which contains a population of over 11,000, it has been decided to proceed with the construction of a reservoir for that town at Meadley Farm, to hold 40,000,000 gallons of water. For a long time past the population have been greatly inconvenienced on account of the inadequate water supply, and the commencement of the reservoirs by the contractors, Messrs. Fleming and Murray, of Annan, is looked upon with much satisfaction.

## MERCHANT STEAM VESSELS AT THE SHIPWRIGHTS' EXHIBITION.

No. III.

In two of our recent issues we have given a brief description of some of the largest steam vessels engaged in the ocean passenger and cargo traffic, models of which were exhibited at the late International Exhibition of naval models at the Fishmongers' Hall. There are many other very fine vessels, models of which have been exhibited, but not for competition, which well deserve attention, and to some of these we shall briefly allude before noticing some of the principal exhibits in the competitive sections.

The first of these is the steel passenger steamer Parisian, 5500 tons, built in 1880 by Messrs. R. Napier and Sons, of Glasgow, for the Allan line. This vessel's dimensions are, length over all, 450ft.; breadth, 46ft.; depth moulded, 36ft.; and she was, until the launch of the gigantic Servia, the largest vessel afloat that had been built of steel. Her engines are of the compound three-cylinder type, and were designed by Mr. Kirk, the senior partner of the firm of Messrs. R. Napier and Sons, and are capable of developing 6200 indicated horse-power. The vessel has realised a speed of nearly sixteen knots. She is constructed on the cellular longitudinal system similar to that adopted in the Servia. The Parisian has extensive passenger accommodation, being capable of taking 150 first-class, 36 second-class, and 1150 steerage passengers, and the saloons and first-class berths are elegantly finished. This vessel is included in the list which had been made by the Admiralty of steamers available to be employed as Government cruisers in time of war.

One of the latest additions to the fleet of the Union Steamship Company is represented by the very handsome full model of the screw steamer Moor, recently built for that company's South African passenger and mail service, by Messrs. James and George Thomson, of Clydebank, near Glasgow, and exhibited by the builders. This vessel is of the following principal dimensions :—Length, 365ft.; breadth, 45ft. 6in.; depth of hold, 29ft.; and the gross tonnage exceeds 3900 tons. Her engines are of the compound surface condensing type, and indicated on the speed trial over 4000-horse power at 69 revolutions per minute, and 85 lb. steam pressure. The vessel attained a speed of nearly 15½ knots on the measured mile. The Moor, like other vessels recently built for the Union Company, is very strongly built. She has a cellular double bottom capable of holding when filled nearly 500 tons of water. The precautions which have been taken in this vessel to prevent loss through collision or striking on rocks, are of an unusually complete character. She is divided into separate water-tight divisions in the hold by means of eight bulkheads, and these arrangements are, it is understood, in excess of the Admiralty requirements to entitle her to a place on the list of steamers suitable for service as Government cruisers. The Moor has considerable passenger accommodation, and this it is claimed has received special improvements, which doubtless the great experience of the Union Company in the requirements of the passenger trade to the South African settlements has enabled them to realise. The vessel has berths for about 170 first-class passengers, and an equal number of second and third-class passengers.

The models and pictures exhibited by the Peninsular and Oriental Steam Navigation Company formed a very fine and interesting collection, including some of the latest of the many recent additions to their large fleet of mail steamers, as well as the two pioneers of the Peninsular mail service. The latter are the wood paddle steamers, William Fawcett, 300 tons, and Royal Tar, 400 tons, with which in 1837 the Peninsular Company, as it was called at that time, commenced its contract for carrying the mails between Falmouth and the Peninsular ports. These vessels appear to have performed their work with great regularity, which was far in advance of the service as carried out by the previously-employed sailing and steam mail packets, and it may be considered that the good work done by the William Fawcett and Royal Tar was the germ of the extensive operations now so successfully carried out by the great firm into which the old Peninsular Company has developed, and which carries the mails not only to the Spanish ports, but to all parts of the East. The exhibits of the Peninsular and Oriental Company are, therefore, of more than ordinary interest from an historical point of view, and indicate very forcibly the development which has taken place in the size and engine power of the company's mail steamers since the days of the Royal Tar.

In the model of the Tanjore, 2263 tons, presented an illustration of the type of screw mail and passenger steamer previous to the opening of the Suez Canal. She was built in 1865; her length is 300ft.; breadth, 38ft.; depth moulded, 28ft. 6in.; indicated horse-power, 2000. The steamers Teheran, and Thibet, a model of which was in the Company's collection, belong to a later period, namely, after the opening of the Suez Canal. These vessels are 360ft. in length, and are of somewhat larger tonnage and greater power than the Tanjore, and were built in 1874. In 1878 the Kaiser-i-Hind, of 4023 tons, was built, having the following dimensions:—Length, 400ft.; breadth, 42ft.; depth, 33ft. Her engines were capable of developing 3800-horse power.

Some of the latest additions are of still larger power; for instance, the Rome, recently built by Messrs. Caird and Co., has a gross tonnage of 5013 tons. Her length is 430ft.; breadth, 44ft.; and moulded depth, 36ft. 2in. The engines, which were also built by Messrs. Caird, are of about 5000 indicated horse-power. The Ballarat, which is still under construction, is a vessel of about equal size and engine power to the Rome, and both are very fine specimens of naval architecture. Some idea of the growth of the fleet of the Peninsular and Oriental Company may be obtained from the fact that while in 1840 its fleet numbered eight wooden paddle steamers of a gross tonnage of 7180 tons and 2330-horse power, this has since grown to a fleet about seven times as numerous, consisting of large iron and steel steamers, having a collective tonnage of 160,000 tons and 150,000 indicated horse-power, with a maximum speed in some of the latest vessels of nearly 16 knots. In all, the Peninsular and Oriental Company's fleet was represented by no less than eleven models, some of them, such as that of the Clyde, being very elegantly finished specimens of model work.

Our want of space precludes an extended reference to the remaining models of steam vessels not entered for competition, which include those of steamers built by Messrs. W. Denny and Brothers, of Dumbarton; Messrs. R. and H. Green, of Blackwall; Messrs. A. McMillan and Sons, of Dumbarton, and other shipbuilders.

In the competitive division of steamers, Section B, we noticed that in most of the classes the competitors were conspicuous on account of their small number.

Class 1 of this section was devoted to models of mail steamers for the Atlantic trade, and although there were so many splendid models of such steamers in the Exhibition, yet there was only one that was entitled to compete actually entered for competition in this class among the two included in the catalogue. This is a new design shown by Messrs. A. McMillan and Sons, of Dumbarton, and was awarded the distinction of honourable mention. The vessel is proposed to be 600ft. in length between the perpendiculars; breadth, 70ft.; depth moulded, 37ft. 9in.; and to be 10,000 tons gross measurement. She is to have twin screws, her engines are intended to develope 20,000-horse power, and the vessel is expected to attain a speed of 20 knots. The design provides for a watertight bulkhead, and transverse bulkheads to divide the vessel into 44 separate sections, and each deck is to be made separately watertight. She is to carry 600 first-class passengers and 700 emigrants. It is not stated amongst these particulars what the proposed displacement is at the load draught, or what the load draught is to be at which the intended speed is to be realised, so it is not clear how much dead-weight cargo the vessel could carry across the Atlantic. There would not, we think, be any difficulty in driving a vessel of the proposed dimensions at 20 knots on a trial trip in smooth water with such a tremendous power, but it is thought that it would be somewhat doubtful whether sufficient cargo could be carried at a reasonable draught, say 26ft., to make such a heavily-powered vessel sufficiently profitable. However, leaving this consideration, it would appear that with the great length of the vessel and her comparatively low side above water she would be likely to ship seas with greater readiness than desirable in a passenger steamer for the Atlantic trade. Moreover her immense proportionate breadth would, we think, conduce to violent rolling in a seaway, and her unusual length as compared with her depth would make it necessary to provide extraordinary means to ensure the necessary strength at the gunwale. But these points, we apprehend, have been pretty satisfactorily explained in the particulars placed in the hands of the gentlemen who acted as judges in the competition, otherwise such a favourable award could not have been given.

In Class 2, again, only two models were entered for competition. This class is for steamers for the direct mail service to Australia in 32 days. The first model, which was awarded the gold medal, is that of the new Orient liner Austral, specially designed for this service and recently built by Messrs. John Elder and Co., of Glasgow. The model is exhibited by Mr. J. Shepherd, the designer to the Orient Company. The lines of the vessel are of beautiful form, and suggestive of great speed, and the model itself is an elegant piece of work, and well worthy of the prize it gained. The Austral is 474ft. in length over all, being 455ft. between perpendiculars; her breadth extreme is 48ft. 3in.; and her moulded depth 37ft.; tonnage gross, 5588 tons. Her displacement at her load draught of 25ft. is nearly 9500 tons, and the maximum indicated horse-power is 6300. The Austral is constructed of steel on the cellular system of double bottom for water-ballast. She is subdivided into sixty-two watertight compartments up to the height of the main deck, and the passenger space is further divided into separate fire-proof compartments, and we understand the pumping arrangements are of unusual completeness. Her engines are compound inverted surface condensing, with a high-pressure cylinder of 62in. diameter, while the two low-pressure cylinders have a diameter of 86in., and the stroke is 60in. Each of the four boilers has six furnaces fired from each end. At the measured mile trial this vessel attained the high speed of 17·75 knots, with an indicated horse-power of 6300, at a steam pressure, 95 lb., and during a six hours' of run she made an average of 17½ knots an hour, with a coal consumption as low as 1·67 lb. per indicated horse-power per hour, a result which her builders and owners may well consider satisfactory. The Austral has accommodation for 120 saloon passengers, 130 second-class, and 300 other passengers.

The other model, exhibited in this class by Mr. J. Elmslie Elmslie, of London, is of a vessel of practically the same dimensions as the Austral, and somewhat greater engine power; the model does not show lines so well adapted for high speed as that of the former vessel.

In Class 3, for steamers of the largest class for trading between Europe and the East, *viâ* Suez Canal, there were again only two exhibitors. Messrs. Short Bros., of Sunderland, exhibited a model of a flush spar deck steamship to carry cargo only and fitted with water ballast; and Messrs. George Thomson and Co., of 24, Leadenhall-street, showed a half model of the screw steamer Aberdeen, 3616 tons, recently built for them by Messrs. Robert Napier and Sons, of Glasgow. This vessel was awarded the first prize—a gold medal. She is a very handsome vessel with good lines. Length, 350ft.; breadth, 44ft.; depth moulded, 33ft. The Aberdeen has been designed with a view to maintaining an ocean speed of about 12 knots, and on her trial trip she attained a maximum speed of 13·74 knots. Her engines are Mr. Kirk's new type of triple expansive engines, and work up to about 125 lb. pressure in the highest pressure cylinder. A full description of these engines was given in a paper read by Mr. Kirk at the recent meetings of the Institution of Naval Architects. It was anticipated that this system of triple expansion of the originally high-pressure steam would admit of a considerable economy in the consumption of coal, a matter of great importance in vessels engaged on such long voyages as from London to Australia. The results of the speed trials on her completion so far fully confirmed this anticipation, and we understand that on her recent voyage to Australia, where she has lately arrived *viâ* the Cape, a saving of about 12 per cent. on the average consumption of coal in ocean voyages has been effected, which is without doubt a great stride in the direction of economy in coal consumption.

Class 4 was set apart for Atlantic grain and cattle steamers, and in this division there were eight models of vessels entered. These included one exhibit, No. 24, of Messrs. Donald Currie and Co.'s Garth Castle and Drummond Castle, employed in the Cape trade. These steamers we have previously alluded to, and it seems to us that such vessels hardly come within the scope of this class. There was also a model, No. 25, of an ocean steamer designed by Mr. Skifter Andersen, of Copenhagen, and one of the Grecian Monarch, recently built for the Monarch line, to which we have already referred, a handsome, well-finished specimen of model work, and which obtained the gold medal. Another model was exhibited by Mr. John Mutch, of London, of a vessel for the cattle and grain trade. Messrs. Short Bros. exhibited three models for competition; and Messrs. R. and H. Green, of Blackwall, also exhibited a model of a vessel for the same trade to go 10 knots an hour at sea and carry 2700 tons weight.

In Section C, Class 1, for steamers for short sea passages, Messrs. Stavenger, Stoberi, and Dok, of Stavenger, Norway, were awarded the gold medal for a half model of cargo steamer for the Baltic trade. Length, 143ft.; breadth, 23ft.; depth, 12ft. 8in. These builders exhibited two other models of vessels for the same trade; and Mr. H. C. Kundsen, of the same port, exhibited a model of a steamer 155ft. long, having accommodation for thirty first-class passengers. Mr. Gunder Swensen, of Christiania, Norway, obtained the bronze medal for a half model of a composite screw steamer for the passenger trade.

A model was also exhibited in this class, by Mr. George Hollingum, of New Cross, of a high-speed paddle steamer, for passenger and mail service. The dimensions of this vessel are: length, 400ft.; breadth, 40ft.; depth, extreme, 19ft. 6in.; and draught of water, 12ft. At this draught the displacement is to be 2467 tons. The engines by which this vessel is to be propelled, at a speed of thirty miles per hour, are to be of 14,000 to 16,000 indicated horse-power. Before venturing to express an opinion on this design, we should like to know something more about the weight of these powerful engines; and considering her shallow depth in relation to her great length, it would appear that this vessel would be more suitable for a river steamer than one for short sea passages.

In section C C, for light draught river steamers, two models were exhibited. One is of a stern wheel steamer, built by Messrs. Yarrow and Co., of Poplar, London, for the river Magdalena, South America. The dimensions are: length, 130ft.; breadth, 28ft.; mean draught of water, 18in. This vessel is propelled by a large stern wheel at the rate of fifteen miles an hour. She is divided into a number of watertight compartments, to localise any damage that might be incurred through striking rocks in the bed of the shallow river on which she runs. This model was deservedly awarded the gold medal.

The other model is of a steam ferry boat, employed for the conveyance of teams and passengers between Boston and East Boston. This model was awarded a silver medal, and represents one of the most complete of the many steam ferry-boats used in Boston harbour.

In concluding this notice of the exhibits in the classes relating to merchant steamers, we must record our satisfaction at the able and impartial manner in which the judges appointed awarded the prizes to the successful competitors, and we believe their decisions will meet with general approval. So far, at any rate, as the collection of models of merchant steamers is concerned, the promoters of the Exhibition have secured a well-deserved success, and the exertions of the honorary secretary, Mr A. D. Lewis, who is a warden of the Shipwrights' Company, certainly merit the hearty appreciation of the public who take any interest in the success and progress of our mercantile marine.

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Bremme's Valve Gear.—The address of Mr. Bremme, whose valve gear we illustrated last week, is 23, Lightbody-street, Liverpool.

Annual Dinner of the Old Pupils of Messrs. Easton and Anderson.—This dinner was held on Friday evening, the 26th inst., at the Café Royal, Regent's-street, being the tenth of these annual dinners. Covers were laid for forty; the members of the firm were as usual entertained as guests.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—John A. Lodge, chief engineer, to the Indus, additional, for the Black Prince, vice Elgar; and Henry W. Elgar, chief engineer, to the Indus, additional, for Reserve, vice Ladge; Alfred Long, engineer, to the Achilles, vice Pattison; George Whitcroft, to the Serapis, vice Leveson; and Frederick W. J. Airey, clerk, to the Revenge, vice Rowe.

Boring for Iron Ore in Cumberland.—In the iron mining districts of Cumberland a great amount of activity has been going on for some time past in the development of the mines and the opening out of new fields. The Crossfield Iron Company has been successful in its boring operations in the vicinity of Crossfield, and have come across a very rich vein of ore; the same company is extending its No. 10 pit. In the Frizington district several companies are prosecuting a search, and in most instances the outlay has been to some purpose, as new shafts are being sunk at several places. The Moresby Coal Company has found a good seam of coal at Distington.

The Conversazione of the Institution of Civil Engineers.—The annual *conversazione* of the President of the Institution of Civil Engineers was given on the 25th ult., by Sir William and Lady Armstrong, in the South Kensington Museum. The museum was at different parts most profusely and tastefully decorated with plants and shrubs of very various kinds, and the large number of guests were entertained by the Hungarian band and the band of the Royal Engineers, as well as by pianoforte recitals, while refreshments were provided on a princely scale in the buffets of the museum and in a marquee specially erected for the purpose. The arrangements were most successfully organised and carried out, and the evening was very much enjoyed by the guests.

## LETTERS TO THE EDITOR.

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

### THE FOUNDATIONS OF MECHANICS.

SIR,—I am just leaving London for a short holiday, and can only afford a short and hurried reply to "Φ. Π.'s" very courteous letter in this week's issue. I have first to thank him for classing myself and Dr. Lodge as "eminent authorities on dynamics," but I fear we can neither of us claim that title. As to the real authorities, I wish "Φ. Π." had heard Sir Wm. Thomson, the *collaborateur* of Professor Tait, declaiming last year, at the Physical Society, against the notion that there could possibly be any difference between himself and Rankine, not upon the foundations of the subject, but upon even the terminology used in discussing it. If "Φ. Π." will only consult the authorities given at the end of my articles, I assure him that he will find I am correct in this.

Nor need I take up space in showing again what I have fully gone into in those articles, namely, that force is expended, not only in overcoming resistance, but also in generating motion; and that it is only thus that the conservation of energy comes to be true. What is measured by the resistance is not generally the whole effort, but the balanced part of the effort; and if the whole effort is thus balanced, then the body remains at rest. The force exerted by a steam engine is measured, as every practical engineer knows, by the area of the cylinder multiplied into the steam pressure—a quantity quite independent of the resistance. Suppose we have two engines and trains, exactly alike, and starting from rest at the same moment, but one of them having 150 lb. pressure in the cylinders and the other 100 lb.: does "Φ. Π." really hold that the one is exerting no more force than the other, because the resistances are equal?

With regard to the word "action," it is obviously a very general one, including every kind of influence which one body may have on another. If Newton had meant, in his Third Law, to speak of force only, he would certainly have used the word "Vis," as he does everywhere else. Thus force is always action, but action is not always force.

I agree with "Φ. Π." so far as that motion is never destroyed, *without producing some equivalent effect*—that is the principle of conservation: but I deny that that effect is always motion. Instances to the contrary are numerous. Take that of heat communicated to a piece of ice, but not sufficient to melt it. At the end of a minute the heating body will have parted with a certain quantity of heat, and therefore has lost motion; but the ice is not in motion as a whole, neither are its particles in any intenser motion than before, for their temperature is the same. The motion of heat has produced its effect no doubt, but that effect is not motion. I think this case answers "Φ. Π.'s" challenge; if not, I can produce others. WALTER R. BROWNE.

P.S.—I have still to ask how it is that the fire starts the train, except through the pull on the drawbar.

Westminster, May 26th.

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SIR,—Your correspondent, "Φ. Π.," has not shown, nor, as far as I see, has he tried to show, that the law of gravity, as generally understood, implies a creation of additional motion in the universe; nor that the amount of motive power expended in the separation of bodies is not restored in the passage of these bodies to their former position. I quite see the difficulty, as he does, of understanding how bodies can reciprocally, and by strictly inherent force, attract to themselves other distant bodies, and that the use of the term "attraction" does not define or describe intelligibly any connecting means by which distant bodies move towards each other. But if the term attraction be received simply as expressing the tendency of bodies to move as though they were pulled or pushed together, proportionally, as the law of gravity expresses them to be, then I do not see that such motion, whether by pull or push, can disturb the foundation of mechanics or the conservation of energy.

But, Sir, the involved structural character of the simplest ponderable bodies should not be overlooked—these being constituted of parts whose movements, both in relative amount and in direction, must be consistent with and might indicate their structure, if adequate means of magnifying them visually were available. These relative movements are probably what determines their peculiar properties, and their special relations to other bodies. Yet the extreme minuteness of the constituent parts forms a most formidable barrier to analysis, or investigation of those "modes of motion" of which ponderable bodies are constructed or built up; and the proposition that bodies are compounded of moving parts, and that the diminished spaces which different bodies occupy with equal masses of matter, as not only a measure of the density of said bodies, but also of a repressive intensity, which causes more rapidly recurrent transit of their atomic parts through the same spaces, this view is one which has much to favour it as a reasonable conjecture; and it is in reference to this view that I would suggest your correspondent, "Φ. Π.," should look for that storage of power which results from the separation of other bodies.

As an illustration, let us suppose a spherical envelope or bubble of, say, 1ft. diameter, whose shell shall admit of being uniformly and gradually diminished by external pressure down to 1in. diameter. If we now suppose that the bubble of 1ft. diameter contains within itself a definite amount of matter in motion, and that this motion cannot be reduced in amount by diminishing its sphere of operation; then the diminution of the bubble to 1in. diameter will necessitate a more rapidly recurrent internal movement of the matter contained therein; and this may readily be understood as restrained motion, or as energy conserved or stored, but cannot possibly be understood as any loss or gain of motion, in the sense of quantity or of amount thereof. For if the path of motion be restricted, the recurrent transits through the same or the remaining space must be more frequent.

The above supposition is therefore not destructive of motion, and to that extent is consistent with the nature of things. But it is evident that, for the purpose of imparting motion to and from distant bodies, a suitable medium of transmission must exist; and Professor Crookes has indicated the presence of fluid bodies of extreme minuteness of subdivision of mass, and which would thus impart great fitness to receive and to transmit the motions of relatively denser bodies to and from each other. And though the rarity of the fluid referred to be most surprising, yet it is thought there may be other more refined media still.

From these considerations the one question which obtrudes itself is, whether, like the bubble, molecular combinations have not definite paths which their special movements secure for them, and thus give to distinct combinations a distinct identity.

Leeds, May 29th. J. RAMSBOTTOM.

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### CORN MILL MACHINERY AND BREAD.

SIR,—At the last two meetings of the Institution of Civil Engineers, some very interesting papers on corn mill machinery, by Messrs. Baker, Simon, and Harding, were read and discussed. On account of the length of the papers, one important point in connection with the use of improved milling and dressing machinery had to be passed over, namely, the alteration in the chemical constitution of the finished flour produced by the system of high grinding—with roller mills—and silk dressing.

Some people may consider that this is a medical question, and out of place in a journal devoted to engineering, but I venture to think that as medical science and engineering go hand in hand in matters of house sanitation, that they may with advantage to both professions work together in matters connected with food supplies. It is well known to chemists and medical men that finely dressed flour, whilst it has advantageously lost the rough exterior coating of bran containing silica, has also lost the second, and nearly all of the third and fourth coatings, containing as they do nitrogenous substances, phosphates, and other salts, which are so necessary for the formation of bone and muscle. When it is borne in mind how large a portion of the community—more especially children—live principally on bread in some form or other, and further that whilst growing they require a large portion of bone and tissue-forming material than at a later period, I think engineers and medical men will agree with me in stating that the processes involved in preparing bread from grain should be such as to leave in the resulting loaf those elements which entitle it to its ancient name, "the staff of life," and that the changes in the chemical composition of bread which are likely to follow an extended use of "high grinding" are well worthy the attention of both professions, and that some information from Messrs. Baker, Simon, or Harding, on the composition of flour prepared by the Hungarian system would be valuable.

It should be borne in mind that in Hungary, where this system was first introduced, rye bread is eaten very largely by all classes, thus counteracting the effects of the extreme purity of the white bread.

The accompanying table is from Dr. Parkes' "Hygiene," fifth edition, p. 222, and show clearly the proportions of the constituent parts of flour and bran:—

*Analysis of Peligot and of Von Bibra (Die getreidearten und das. Brod).*

| In 100 parts of | Flour. | Bran. |
|---|---|---|
| Water | 14· | 10·3 |
| Fatty matters | 1·2 | 2·82 |
| Nitrogenous substances insoluble in water—gluten | 12·8 | 10 84 |
| Nitrogenous substances soluble in water—albumen | 1·8 | 1·64 |
| Non-nitrogenous substances—dextrine sugar | 7·2 | 5·8 |
| Starch | 59·7 | 22·62 |
| Cellulose | 1·7 | 43·46 |
| Salts—phosphates, &c. | 1·6 | 2·52 |
| | 100·0 | 100·0 |

It may be noted that the above figures are the means of fourteen analyses, and that the flour and bran from which the analyses were made were ground in the ordinary stone mills, and was not nearly so finely dressed as is now the custom. The finely dressed flour of the new system produced by roller mills contains even less of the glutinous and salt-containing coats than the samples analysed.

STEPHEN H. TERRY, Assoc. Mem. Inst. C.E.

London, 25th May.

[Our correspondent should bear in mind that it is not what is eaten, but what is assimilated by the system that determines the value of a food. Bran is practically indigestible by most stomachs, and, therefore, notwithstanding the apparent value of its constituents, its worth as a food is very small.—ED. E.]

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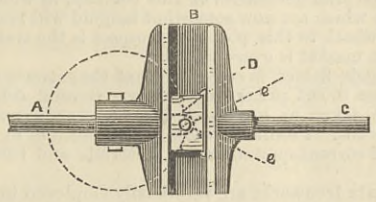
### AMERICAN PATENTS.

SIR,—Every week you give us extracts from the American Patent-office Journal, which I read with much interest. I do not envy you the task involved in picking out something really good from the vast mass of absurdities or trivialities patented every week in the States.

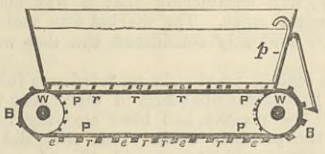
My object now is to call attention to the utter inutility of the United States examination of patents for novelty. Every week antiquated inventions are patented without a question. I venture to send you two from the last Journal which has reached this country:—

"258,125. Mechanical movement. Charles H. Roberts, Evansville, Ind. Filed Feb. 15th, 1882. (No model.) Claim: (1) The




combination of the crosshead B and rods A and C with the shaft F' crank E, pin e', and block D, substantially as described. (2) The combination of the crosshead B, strap H, and guide-rod G with the shaft F, crank E, pin e', and block D, substantially as described." Here we have the dog link, as fitted in thousands of donkey pumps, patented.

The next is a real gem. What possible form of endless belt remains now to be patented for this purpose? I shall not know until next week's Journal is published:—"258,190. Fertiliser feeder for grain drills. Alfred H. Worrest, Salisbury Township, Lancaster County, Pa. Filed Nov. 19th, 1881. (No model.) Claim: In a




fertiliser feeder, the endless belt B, composed of the plates P, each having one flanged edge e, linked together, all constructed, arranged, and operating substantially as shown and described, for the purpose specified." These examples are two out of hundreds that might be cited. Only a few weeks ago a man obtained a patent for the use of riggers and belts in driving machinery. J. D.

London, May 30th.

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### THE IDENTIFICATION OF SHIPS.

SIR,—The German brig Fredericke, Captain Stramwitz, of Stralsund, has arrived in the Tyne, and reports having passed a capsised vessel in lat. 56.37 long. 3.50 E. from Greenwich, with keel upwards, presumably a schooner, 75ft. keel, clean bottom, not damaged.

Captain Stramwitz is evidently a very careful, observant man, and has done his part well in endeavouring to secure the identification of the unfortunate "bottom upwards." But why should it be necessary for such cruel care to be taken, and with doubtful result? Why should captains have to measure keels in, perhaps, rough seas, and from the look of the bottom guess at the rig of a lost ship? If owners would take the simple, cheap, and obvious precaution of painting in large letters the name, number, and owning port on the bottom as well as on the upper parts of their vessels, they might be certain of tidings of them whenever they were in the unfortunate predicament of the supposed schooner.

Perhaps they have never thought of the expedient. Perhaps they have, but do not care to put it in practice. Many a man at death leaves his affairs in a hopeless muddle because during his lifetime he could not face the task of making his will. Many a one seems to think that making *post obit* arrangements has some mysterious effect in bringing about the undesired end. Perhaps shipowners have an analogous feeling that in adopting my suggestion they might diminish the stability of their ships; or perhaps they hesitate to give to the strange denizens of the deep so much information as to what passes over their heads. However that may be, I think the Board of Trade or Lloyds' Underwriters' Association, or whoever the proper authority may be, might well insist on ships being properly marked on all their parts; so that whatever of them might be found or seen, identification should be immediately possible without the trouble good Captain Stramwitz was put to. AQUARIUS.

Redcar, May 29th.

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

(*From our own Correspondent.*)

THE experiments which are being made in this district to ascertain the suitability of Staffordshire cinder pigs for the manufacture of steel by the Thomas-Gilchrist process are proceeding satisfactorily. It has been demonstrated that our cinder pigs at 37s. 6d. or 38s. per ton—the cheapest in the country—are a very fair sample of a good basic Bessemer pig—they are high in phosphorus and manganese and low in sulphur; in fact they often contain as much as 3 to 4 per cent. of phosphorus.

Upon 'Change in Wolverhampton yesterday and in Birmingham to-day—Thursday—there were shown portions of a bar of steel that had been rolled from an ingot obtained from such iron melted in a cupola and passed through a basic-lined converter at the works of the Patent Shaft and Axletree Company, at Wednesbury, by the committee of ironmasters, who, with Mr. Thomas, are conducting the experiments. The bar was an inch across and half an inch thick, and it had been tested to compete with a bar of high-class merchant iron. Doubled up under a heavy sledge-hammer it showed no signs of breaking; broken in another part and then re-welded, it was afterwards bent in the weld, yet showed no fracture. The experiments are still in progress.

Because of these experiments certain makers did not hesitate to ask £2 1s. 3d. and £2 2s. 6d. for cinder sorts. Part-mines were plentiful at £2 12s. 6d. up to £3 2s. 6d., according to quality; and all-mine iron might have been got at different rates from £3 10s. down to £3 5s., and occasionally £3 2s. 6d. Northampton and Leicestershire and Derbyshire iron was plentiful at from £2 10s. down to £2 7s. 6d. easy. Bessemer sorts ranged from £3 7s. 6d. down to £3. Few people would look at the higher quotation which was that named by the agents of the Barrow company, while £3 5s., but no less, would have been readily taken by the representative of the Tredegar Company; and buyers made known that they were procuring Wigan hematites at the £3 in favourable purchases.

Most of the mills at which sheets for galvanising and deep stamping are rolled have begun again after the holidays; and the hoop and strip mills generally, together with the mills at which heavy sections of marked iron are turned out, are fairly well supplied with orders. Narrow plates for girders and also angle and tee iron are better off for work; but boiler-plate orders are sought after, and common smithy bars are somewhat less in request.

Sheets needed by the galvanisers were to-day stronger in price. Yet there was no quotable change upon the week. The Association of Sheet-makers are holding well together, and it is to the expectation of buyers at a distance that the combination will enable higher rates to be got that the recently improved demand is largely due. No more in other denominations than in sheets is there any quotable change upon the week. The sheet-makers find no difficulty in securing the rates, which are better than before the Association was started by about 10s. per ton on the earlier minimum.

The galvanised sheet trade shows decidedly more activity; orders both on home and foreign account coming in more freely than has been the case for some time. Prices too are firmer. Bundled and delivered in London, 24 w.g., are £14 10s. at lowest, and some of the best firms are asking £15. For 26 w.g. £16 10s. to £17 is the price; and for 28 w.g. £18 10s. to £19. Delivery in Liverpool is 5s. under these prices. The recent heavy consignments from England have affected the Australian market in such a manner that holders are willing to part with their goods at prices which mean a reduction of 5s. per ton. This is checking work on speculative consignment account.

Some heavy roofing orders are being executed by Messrs. Morewood and Co., of the Lion Galvanising Works, Birmingham. The firm have received from one of the largest manufacturers of spinning machinery in this country an order for the whole of the roofing for extensive spinning mills to be erected in Madras. The framework and large gutters are stamped by special hydraulic machinery and are painted. The total weight is about 700 tons, and the order is worth some £9000. A great feature in their special type of roofing is the large proportion of steel used, strength combined with lightness being thereby attained. A still larger contract is in hand by Messrs. Morewood for the roofing of a large new steel works in the Middlesbrough district. The roofing is of patent type, and covered with corrugated sheets. On this order and on the one previously mentioned full time is being made at the firm's Woodford Ironworks, Soho. At the Lion Galvanising Works, Birmingham, orders for galvanised sheets are being got out rapidly. Indeed the firm report that all their eight sheet mills are running full time without being able to supply nearly all their requirements.

Amongst the foreign railway work which is under execution in the district, I may mention three fixed spans and a swing bridge for Mexico. The London and North-Western, the South-Western, and the Great Eastern Railway Companies are all customers for bridge and roofing work just now.

One local engineering firm has a large bridge in hand for Australia, besides large numbers of building girders for Adelaide and spacious iron roofs for the East Indies, under the auspices of the Crown Agents for the Colonies. Another district firm is now executing an order for some large gasometers and various appliances for different parts of our colonial possessions.

Although the tube trade generally is quiet and without much prospect of further business at present, some few of the chief firms are busy. The total requirements this year of the London and North-Western Company are estimated to run to 2000 tons, and contracts are now being let.

A big order, reported to be worth some £20,000, for water-pipes for Kimberley, South Africa, is also said to have been placed here. Messrs. James Russell and Sons, Limited, of the Crown Tube Works, Wednesbury, are busy on tube orders for Australia and Canada, and on iron telegraph posts for India. One of the most recent orders for pipes booked is one for five miles of 9in. size, to be tested at 300 lb. per square inch.

Light ironwork for the carriage trade is being turned out in large quantities in the Wednesbury district. Messrs. John Rigby and Sons have some heavy orders in this department.

Constructive gas ironwork is affording a fair amount of employment. For the Dudley Gas Company and for the Tottenham Gasworks large gas-holders are also being made, as also are roofs for the Bradford Gas Company.

The Monmore-lane Iron Company, of Willenhall, is increasing its capacity by laying down a new rolling mill. The engineering departments of their works are now under the superintendence of Messrs. Onions Bros.

The directors of the Pelsall Coal and Iron Company have issued a report showing a net profit on the past year's working amounting to £9618 15s. 1d., and a dividend of 5 per cent.

Dulness continues to characterise the local coal trade. The only semblance of activity is in the demand for forge and furnace coal, and for this great competition and underselling exists. The demand for slack and locomotive steam coal has somewhat fallen off. There is less call for fuel on account of the local glass works, because of the depression now existing in the superior branches of manufacture in that industry. Some of the glass houses are scarcely making four days per week. House-coal buyers are looking for an early drop in quotations.

The Hanley Colliery Company, Limited, has reached the ten-feet coal. The company has been drawing coal from the upper seams for some months. At a depth of 426 yards, it has now come upon what are known as the "lower series" of the North Staffordshire coal-field. It is calculated that enough fuel has been found to allow a daily output of 1000 tons per day for fifty years. Hitherto 500 tons has been the amount raised; but the firm is laying down fresh plant and fresh machinery with a view to winning 1000 tons daily. The factories and workshops of the Hanley district have lately been supplied by coal on which they have had to pay carriage

and they are consequently looking for benefit now that fuel can be obtained at home.

The Staffordshire Potteries Waterworks Company has been able to recommend a dividend at the rate of 6 per cent. per annum. The company has now, as compared with last year, an increased rental of £983, and its books show an available balance of £6240.

## NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

*Manchester.*—So far as actual business is concerned there is but little to report this week, Whitsuntide being the annual holiday of this district, when work as regards nearly every description of industrial occupation is suspended, except for one or two days at the outside, and market transactions are curtailed to the narrowest possible limits.

Tuesday, which is the only 'Change day this week, brought together only a very thin attendance in the Manchester iron market, with very little business doing and prices nominally unchanged, although sellers in some cases could be found at a trifle under last week's rates. Lancashire makers of pig iron were asking 45s. to 46s. less 2½ for forge and foundry iron delivered equal to Manchester, and only in exceptional cases have they been disposed to go below these figures to secure orders. In Lincolnshire iron, which is now the cheapest brand coming into this market, and with which local makers find it very difficult to compete, sellers have been offering at prices ranging from 44s. 6d. to 45s. for forge, and 45s. 6d. to 46s. for foundry less 2½ delivered here, and on the basis of these prices moderate sales are reported during the week. Other district brands for the present seem to be out of this market in the face of the low prices ruling for Lincolnshire.

The finished iron trade continues very quiet so far as bar iron makers are concerned, and in some cases they would now be willing to book prompt specifications for good orders at £6 5s. to £6 7s. 6d. per ton delivered into the Manchester district. Plates and sheets have been meeting with a moderate inquiry at about £9 to £9 10s. for best boiler plates and £7 15s. to £8 for common qualities, and about £8 5s. per ton for good Staffordshire sheets delivered into this district. One or two good orders for points and crossings, one for the Hull Dock Company and another for the Table Bay Harbour, have also been placed in this district.

There is almost a general cessation of work for the Whitsuntide holidays both at the ironworks and in the engineering shops of the district, which, apart from special work, is in most cases extending over the whole of the week. The holidays, however, are not, as the case has been during recent years, coming upon the engineering trades at least as a welcome release from over-production. Works generally are well supplied with orders, and many of the principal establishments have been running overtime for a considerable period. Locomotive builders generally are very busy, and in this branch of trade, although there are comparatively few engines at present being built for England, there have been considerable inquiries coming into the market during the past fortnight for export to the colonies and the Continent, and deliveries on account of large orders for France recently placed in this district are now being commenced.

During the past week I have had an opportunity of inspecting a practical application of electric lighting to a large engineering works in this district. Messrs. Mather and Platt, of Salford, who are undertaking the manufacture, for the Edison Company, of electric lighting plant, including specially designed engines for driving the dynamos, have illustrated in their own works, on a scale which has not hitherto been attempted elsewhere under similar circumstances, the special adaptability of the Edison incandescent lamp for all the requirements of a large engineering establishment. At present the firm have in their workshops eighty-one lamps in a circuit, and fifty-three in the offices, making a total of 134 lights, the electricity for which is induced from two dynamo electrical machines, each of 60-light power, driven by a six nominal horse power single cylinder engine of the ordinary type manufactured by themselves. The lamps, which consist of a thin filament of carbon, hermetically sealed in small pear-shaped glass globes, are for the most part carried on the now disused flexible gas brackets, although a few special chandeliers have been fitted up in the offices, and have so far worked so satisfactorily, without any interruption by breakdown, that Messrs. Mather and Platt, who require upwards of 1000 lights for the whole of their works, intend carrying the system throughout, and it is estimated that this will be effected at an outlay, including the cost of engine power and necessary replacement of lamps, not greater than is already entailed by the use of gas, whilst a much better light will be secured. In passing through the works the most noticeable feature was the perfect steadiness of the lights, whilst the readiness with which they could be brought into any position and the full light concentrated by means of small paper shades upon any particular point was an important advantage, both in the drawing office, where the draughtsmen could work without shadow, and at the fitters' benches, where the men could bring the lights close upon any special portion of their work in a manner which would be altogether impossible with gas. Messrs. Mather and Platt have certainly afforded a very satisfactory illustration of the adaptability of electric lighting to engineering works; and another matter of interest to engineers is the opening which the gradual introduction of electric lighting is affording for the manufacture of high-class machinery and other plant requisite for carrying out the system.

A new lattice girder bridge, with a single span of 125ft., crossing the Irwell between Pendleton and Broughton, which has been erected from the designs of Mr. Arthur Jacob, the Salford borough engineer, will be opened this week by the Mayor of Salford. The new bridge, which will be called the Cromwell-road Bridge, has cost £10,000.

In the coal trade pits have been stopped for the greater part of the week, as even in districts where business is not so much actually interfered with by the holidays, the pressure of the holiday excursion traffic on the local lines, and the stoppage of various sections of the canals for repairs, almost completely stop the usual means of transit from the collieries. Apart from this the general stoppage of works causes to a large extent a temporary suspension of requirements for manufacturing purposes, and the season of the year keeps down the demand for house fire consumption. In the Manchester district the principal colliery firms are this month making reductions on their pit and wharf prices, averaging, as a rule, from about 5d. on most classes of fuel for manufacturing purposes up to 10d. per ton on best coal, but until business is resumed after the holidays it is scarcely possible to say what effect this will have on the market, or whether the movement will be followed to any extent in other districts.

*Barrow.*—The slight improvement I was able to note last week still continues in the hematite pig iron market of this district. The demand has improved from several quarters, but not much new business is doing, partly on account of the scarcity of second-hand parcels and partly because of the present low prices. The production of iron at the furnaces remains about the same, and smelters do not appear to be making any serious efforts to reduce it. One furnace has been blown out during the week in this district in order to minimise the output a little. Stocks are not increasing, and although the tonnage of metal in large parcels to America is only slow for the time of the year, a very heavy tonnage is being sent by small craft to Liverpool where it is transhipped. The price for No. 1 Bessemer is 55s.; No. 2, 54s.; No. 3, 52s. per ton f.o.b. three months' delivery. The Whitsuntide holidays have to some extent interfered with the progress of business, and it is possible some sort of a revival may take place when they are over. The activity in the steel trade is fully maintained, although new business is limited. Prices are again down 2s. 6d. per ton. There is nothing new relating to iron shipbuilders, except that inquiries are being made in fair numbers. Other industries in steady employment. Iron ore quiet at unchanged prices.

The North Lonsdale Iron and Steel Co. at Ulverston has blown out another furnace. There are now three furnaces in blast at these works.

A company has been formed in London to work the coal pits at Workington belonging to Mr. Curwen, which have been closed for a long time.

The railway in course of construction from Preston to Southport has just been opened for traffic as far as Longton, four miles south of Preston. A stone bridge is being constructed over the Ribble at Preston, and when this is completed the whole length of the new line will be opened out.

Considerable progress has been made with the work of repairing the Whitehaven wet dock, and it is expected to be ready for traffic in a few days.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THIS has been a week of holidays, so far. Usually, the Sheffield artisan takes the first two days—Whit-Monday and Whit-Tuesday. This year, owing to the very fine weather, there has literally been no work done up to the time of my writing, except in one or two departments, which can scarcely be said to "stand" at any time. Engineers and boiler-makers have been very busy making the usual repairs for which holiday-time affords favourable opportunity.

At the Toledo Steel Works—Messrs. J. H. Andrew and Co.—a steel melter named Michael Smith lost his life on Sunday morning, while the firm were having old boilers replaced by new. As an old boiler was being removed, a breakdown caused it to tilt against the wall, and Smith, suddenly stepping out of an office door at that particular instant, was wedged against the wall and crushed to death. It says a great deal for the carefulness of the engineering and boiler-making firms that so few accidents occur in the difficult work of renewing, repairing, and removing the many heavy masses of machinery in the various Sheffield works.

The Sheffield Telephone Exchange makes very rapid progress, thanks in a large measure to the attention given to it by the managers, Messrs. Tasker, Sons, and Co., Angel-street. One day last week—the 24th inst.—I am informed, there were 240 messages sent in one hour, between ten and eleven o'clock. The day's return was 1294. On the following day—Thursday—there were 1290 messages. These are the two highest days on record.

Messrs. Tasker, Sons, and Co. have recently made several interesting experiments with the view of utilising the electric light for household purposes. These experiments have been suggested by visits to the Electrical Exhibition at London. I saw several ingenious appliances in this establishment which promise to give us the electric light in our dwellings, to be turned on and off with the facility of gas. The want of this power is a difficulty in dealing with the household application of the electric light. This would have to be supplied from a common centre, the town being divided into circuits for the purpose.

The alleged frauds upon the Sheffield Wagon Company, Limited, for which their late secretary, Mr. J. Unwin Wing, accountant, is now in Wakefield prison awaiting his trial at Leeds Assizes, amount to a larger sum than was at first anticipated. The directors have discovered three cases which cover a sum of £30,000, but as £4000 has been repaid, the net loss will be £26,000. The company is in good condition, and has a reserve of uncalled capital far more than sufficient to meet the deficiency, if it required to call it up, which it does not.

A great strike of ironworkers for an advance of wages is threatened in the United States. This may cause another big boom upon the iron industries of this country, in which case certain concerns which are now somewhat languid will receive a fillip. A slight drawback to this pleasing prospect is the statement that the American market is over-stocked.

Rails are again flatter, in consequence of the extreme competition causing makers to cut prices very keenly. Several contracts have recently been taken as low as £5 12s. 6d. per ton, and I hear of others at £5 15s. Profitable work is not possible at such prices in the face of current quotations for materials and ruling rates of wages.

The Parkgate Ironworks are very busily employed in the production of plates and bars. Additional puddling furnaces—about a dozen of them—in the old rail mill have been brought into use. These furnaces have been idle for five or six years. Generally, however, the iron trade is flat, buyers still holding off, in the hope of lower quotations ruling.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE Cleveland iron market at Middlesbrough on Tuesday last was but poorly attended. It could scarcely have been otherwise on a Whit-Tuesday, and considering that it was one of the days appointed for Redcar races. The market was soon over, as those who attended it evidently considered the day was not one for business.

The improved feeling previously reported was fully maintained. It was reported that a principal firm of merchants who have long been "bearing" the market had been covering their sales very largely during the previous week. This they did by giving the makers' prices. They paid, it was said, 43s. 6d. per ton for their purchases from makers within the ring, and 43s. for those from outsiders. The transactions were effected in every variety of way, some portions even in the Liverpool and Manchester Exchanges. The total so bought amounts to from 10,000 to 11,000 tons, and was all for early delivery. This sequel to the long-continued fight has very much strengthened the position of the ironmasters, and has made them firmer than ever in their quotations. The price of No. 3 g.m.b. must be taken to be 43s. 6d. f.o.b. Middlesbrough, forge iron being 1s. less, and warrants from 43s. 3d. to 43s. 6d.

The manufactured iron trade remains about the same as regards prices, viz., £7 5s. for ship plates, and £6 10s. for angles and bars. There is, however, a better tone discernible, in sympathy with the improvement in pig iron. There are more enquiries and great pressure for immediate delivery. The recent strike of ironworkers had the effect of preventing the manufacture of a large quantity of iron, the want of which is now being felt, and full list prices are being given in many cases if quick delivery be guaranteed. Most of the manufactured ironworks were in operation on Tuesday, the ironworkers having contented themselves with Monday only as a holiday. The employers are glad of the extra day to get on with pressing contracts, and the workmen having exhausted all their funds in the recent strike were also glad to work. They do not care for holidays without money to spend. At some of the Stockton mills, however, they were idle on Tuesday as well as Monday.

The South Stockton Rolling Mills Company has given notice to all hands that it will close for a month. It will be remembered that these works were recently re-started for the manufacture of angles and bars. The finishing mills will not be ready until July, and they would not have started in any case before that except for the temporary demand for puddled bar which sprung up a short time since. That demand has now disappeared; hence the decision arrived at. The release of a certain number of puddlers just as the hot weather is coming on will be very helpful to the other manufacturers, who usually suffer in their forge departments at this time of the year from that cause, as well as owing to the withdrawal of a number of their men for militia purposes.

The coal trade is extremely flat, and prices are tending downwards. Coalowners complain bitterly, that what with legal restrictions, accidents compensations, and low prices, there is no profit obtainable, although they are gradually exhausting their royalties at a rapid rate.

Mr. Charles Hill, managing director of the Stockton Malleable Iron Company, has been seriously ill for several weeks. It is to be hoped that summer weather will restore him to health. His unusual energy and ability as an iron maker, as well as the great length of time he has occupied a leading position in the trade, make him one of the best known and most respected inhabitants of the Cleveland district.

A most disastrous fire occurred a few days since at the South Stockton shipyard belonging to Messrs. Richardson, Spence, and Co. Although close to the river, water could be obtained only with difficulty, because the tide was at the lowest. Unfortunately, from some unexplained reason, there was also no pressure on the mains of the Corporation Waterworks. Consequently the fire had its own way for some time, and burned down the joiner's shop, storehouse, and moulding loft. The damage is estimated at £20,000, most or all of which is covered by insurance. The fire commenced at ten o'clock at night, but Mr. Richardson, the managing partner, knew nothing of it till he arrived by train at Stockton the next morning.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

BUSINESS in the Glasgow iron market was considerably interrupted in the earlier part of the week owing to the holidays. The warrant market was closed from Wednesday till Tuesday, and the export business as well as the home trade appears to have been somewhat limited in comparison with former weeks. There is now an impression that the amount of the foreign trade will be rather less during the summer months, as is, indeed, usually the case. The additions to stocks have not been very large, and some strength has been imparted to the market by the intimation that a steam vessel has been chartered, in addition to the ordinary lines, to carry 1000 tons of pig iron to New York, the inducement held out to the consigners being a freight charge of 4s. per ton less than that charged by the ordinary steamers.

When the warrant market closed for the holidays on the 24th inst., business had been done at from 47s. 3½d. to 47s. 3d. cash. On Friday forenoon the market was stronger, with business at 47s. 4d. to 47s. 5d. cash, and 47s. 6d. to 47s. 7½d. one month; the afternoon quotations being 47s. 4d. to 47s. 3d. cash, and the tone of the market then somewhat quieter. On Wednesday the market was steady, with business from 47s. 2d. to 47s. 3d. cash. To-day—Thursday—the market was quiet but steady; business at 47s. 3d. to 47s. 4d. cash.

There is not much change in the quotations of makers' iron, which are as follows:—Gartsherrie, f.o.b. at Glasgow per ton, No. 1, 58s.; No. 3, 53s. 6d.; Coltness, 59s. and 55s.; Langloan, 59s. and 54s.; Summerlee, 57s. and 50s. 6d.; Calder, 57s. and 51s.; Carnbroe, 51s. 6d. and 48s. 6d.; Clyde, 51s. and 49s.; Monkland, 48s. 6d. and 47s.; Quarter, do. do.; Govan at Broomielaw, 49s. and 47s.; Shotts at Leith, 59s. and 54s. 6d.; Carron at Grangemouth, 49s. 6d.—specially selected, 52s.—and 48s. 6d.; Kinneil at Bo'ness, 47s. 6d. and 46s. 6d.; Glengarnock at Ardrossan, 51s. 6d. and 48s. 6d.; Eglinton, 48s. 6d. and 46s. 6d.; Dalmellington, 48s. and 47s.

The malleable trade is still well supplied with work, although the feeling in the trade is not quite so satisfactory. For some time several of the makers have been selling bars at rather less money, and they have now issued circulars formally intimating a reduction of 5s. to 10s. per ton. It is expected that the other makers will follow suit.

There is a continuance of activity in the engineering trades with some exceptions.

The coal trade in the Glasgow district is in a satisfactory state for the season of the year, the shipments being comparatively large, and prices, though they cannot be said to be advancing, are firm. There is also a large business being done both at the eastern and western ports, and it is worthy of special note that the shipments at Burntisland during the week have amounted to the large total of 17,455 tons. All the Fife collieries have been very busy since last week's conference on the wages question, and in some instances prices are quoted rather higher. The miners in Fifeshire have consented to stop the system of restricting production, and on this condition the employers have returned them the recent reduction of 12½ per cent. A similar concession has also now been made to the miners of the Lothians.

In a large number of branches connected with the iron trade fresh demands are being made by workmen for an advance of wages. An increase has been given by Messrs. Henry Murray and Co., shipbuilders, Dumbarton, to their rivetters. The fitters, turners, smiths, and pattern-makers, employed by the engineers of Kirkcaldy, have requested an advance of 1½d. per hour. The operative engineers in the works of the Caledonian Railway Company, St. Rollox, Glasgow, have been three weeks on strike for an advance of 1½d. per hour, and a strike for a similar increase has occurred among the Glasgow iron dressers. This week the Clyde shipjoiners, who presently receive 7d. per hour, have demanded an additional ½d., and desire an answer to their request by the end of the week.

In the course of the past month twenty-seven vessels, with an aggregate tonnage of 32,000 tons, have been launched from the Clyde shipbuilding yards, as compared with thirty-one vessels of 36,000 tons in the corresponding month of last year.

The death has taken place, at a ripe age, of Mr. Wm. Neilson, head of the extensive firm of the Mossend Iron and Steel Company. Mr. Neilson was the founder of this firm, which he originated in 1840.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE great event of the present week is the gathering of the Bath and West of England Agricultural Show at Cardiff. The first three days were great successes, and the show of implements, &c., of a high order.

The process of hay harvesting by steam, shown by Mr. Charles Phillips, of Newport, excited general interest; and his hay elevator came in for commendation. The grubbers, ploughs, harrows, were of the first character. One of the novelties in the field was Thomas's Patent Lift. A noteworthy fact was the close and intelligent examination given by the Glamorganshire farmers to the various scientific appliances for aiding agriculture, and if a good harvest be obtained this year I shall expect that substantial purchases will be made from the various northern and midland firms.

The engineering world took great notice of the pulsometers which were erected and placed in action on the field.

The coal trade of the past week has been exceptionally good. From Cardiff, Newport, and Swansea over 100,000 tons of coal were shipped, Cardiff alone shipping 47,000 tons.

The demand for best coal is very good and prices are firm. I was assured by one of the leading coalowners of the Cardiff district this week that in all respects the coal trade as regards first qualities is excellent and the demand larger than has been known. For seconds the inquiry is not so good.

The iron trade is dull. Little fresh business to hand, but makers are not quoting low, as there is a prospect of a good trade in a little time.

FIND OF COAL AT WORKINGTON.—In one of Mr. Mulcaster's coal pits at Workington workmen have been engaged for a long time in deepening it to try and find a thicker seam. A large amount of money has been expended in the effort, and the result has proved the correctness of the surmises, as a fine thick bed of coal has been discovered.

# 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.

*23rd May*, 1882.

2419. ELECTRIC ARC LAMPS, W. H. Akester, Glasgow.
2420. DECORATING WALLS, W. S. Morton, Edinburgh.
2421. EXHIBITING ADVERTISEMENTS, J. Hickisson, London.
2422. INDICATING LENGTH, J. & J. Darling, Glasgow.
2423. MOTORS, W. Thompson.—(*S. Marcus, Vienna.*)
2424. ENGINES, A. Pattie and G. Robertson, Glasgow.
2425. ELECTRIC LAMPS, J. Barrier and F. Lavernéde, Paris.
2426. BOTTLING LIQUIDS, F. Foster, London.
2427. ERASING KNIVES, C. H. Wood, Sheffield.
2428. PRINTING, J. Imray.—(*A. A. Knudson, U.S.*)
2429. WATER METERS, B. D. Healey, Brighouse.
2430. KILNS, J. Raynes, Llysfaen, & B. Healey, Brighouse.
2431. MOTIVE POWER, W. Muir, New Cross.
2432. ELECTRIC LAMPS, G. G. André, Dorking.
2433. SEWING MACHINES, A. Greenwood, Leeds.
2434. TENNIS RACQUETS, J. Gibb, London.
2435. ORDNANCE, J. H. Johnson.—(*A. Deport, Paris.*)
2436. CLOSING VESSELS, J. F. Farwig, London.
2437. TELEPHONIC APPARATUS, W. R. Lake.—(*C. E. Chinnock, Brooklyn, U.S.*)
2438. MILLSTONES, E. Edwards.—(*F. Iwand, Breslau.*)
2439. SHOE UPPER, A. J. Boult.—(*S. Wiegand, U.S.*)
2440. ROTARY ENGINES, H. Haddan.—(*L. Wing, U.S.*)
2441. COMPRESSING FODDER, J. Wetter.—(*M. Laporte, Paris.*)
2442. DARNING LASTS, G. A. Cochrane, Montreal.

*24th May*, 1882.

2443. CLIPPING HORSES, C. P. Collis, Alresford.
2444. RAILWAY BRAKE, F. Hebblethwaite, Manchester.
2445. STOPPING CARS, J. H. Betteley, London.
2446. STEMS of MATCHES, F. Byrt, Peckham.
2447. CLOSING WINDOW CURTAINS, R. Henry, Edinburgh.
2448. YARN WINDING, E. Ashworth, Bolton-le-Moors.
2449. TREATING LYES, F. Allan, Warrington.
2450. LOCKING NUTS, H. Kemmler, London.
2451. TRANSMITTERS, C. Moseley, Manchester.
2452. ELECTRIC LAMPS, J. Wetter. — (*L. Nothomb, Belgium.*)
2453. HUBS, H. A. Bonneville.—(*J. Lajeunesse and E. Armant, Montreal.*)
2454. ROTARY CUTTERS, H. A. Bonneville.—(*E. Salomon and E. Armant, Montreal.*)
2455. RAISING WINDOWS, R. J. Iron, Dover.
2456. DYNAMO-ELECTRIC MACHINES, J. Swalwell, Battersea.
2457. DETERMINING the SITUATION of VESSELS at SEA, P. M. Justice.—(*J. J. Oginaga, Madrid.*)
2458. STOPPERS, N. Thompson, Brooklyn, U.S.
2459. SWEEPING MACHINE, B. W. Stevens, Birmingham.
2460. THRASHING MACHINES, P. Gibbons and A. S. F. Robinson, Wantage.
2461. FLOUR, W. R. Lake.—(*W. Warren, Chicago, U.S.*)
2462. MARKING APPARATUS, C. A. Collins, Trowbridge.
2463. LIFTING APPARATUS, T. Stead, Leeds.
2464. PULPING APPARATUS, W. H. Crispin, London.
2465. SLIDE VALVES, J. W. Joyce, Durham.
2466. TELEGRAPHIC APPARATUS, W. R. Lake.—(*F. van Rysselberghe, Belgium.*)
2467. COTTON PRESSES, W. R. Lake.—(*S. B. Steers, U.S.*)
2468. BELL ALARMS, W. Thompson.—(*F. N. Cottle, U.S.*)
2469. SHUTTLE BOX, W. Thompson.—(*E. Lepainteur, Paris.*)
2470. ALARM CLOCKS, W. R. Lake.—(*Jerome and Co. (Incorporated), New Haven, U.S.*)
2471. COLOURING MATTERS, R. Meldola, London.
2472. OVERSHOES, C. Mayer, Cologne.
2473. PIANOS, F. C. Glaser.—(*A. Battes, Germany.*)
2474. FLUID METERS, C. D. Abel.—(*C. Schreiber, Paris.*)
2475. REAPING MACHINES, T. Culpin, London.
2476. ROTARY ENGINE, W. Southwood, Blackheath.

*25th May*, 1882.

2477. FIREPLACES, J. Smith, Liverpool.
2478. STRETCHING FABRICS, J. Ashworth, Rochdale.
2479. STOPPERS, J. S. Davison, Sunderland.
2480. ELECTRICAL INSULATION, F. Field, Beckenham.
2481. LOOMS, W. Thompson, Blackburn.
2482. ORGANS, &c., J. B. Hamilton, London.
2483. EMBROIDERING, W. Gedge.—(*E. Cornely, Paris.*)
2484. METALLIC ALLOYS, G. A. Dick, London.
2485. DUST APPARATUS, L. Fiechter. — (*Kirk and Fender, Minneapolis.*)
2486. NET APPARATUS, J. M. Croisdale, Manchester.
2487. VELOCIPEDES, L. C. Tipper, Balsall Heath.
2488. DRYING APPARATUS, G. W. von Nawrocki.—(*S. Adamczewski, Poland.*)
2489. VALVE GEAR, W. R. Dawe, Grantham.
2490. RULES, H. Green, Handsworth.
2491. BATTERIES, C. Vincent.—(*W. Elphinstone, Canada.*)
2492. CUTTING MACHINES, W. R. Lake.—(*R. D. Evans and R. M. Green, Washington, U.S.*)
2493. HYDROCHLORIC ACID, J. W. Leather, St. Helen's.
2494. BRAKES, J. Hollinshead, Newcastle-under-Lyme.
2495. SOUNDING ALARMS, W. H. Willats, Canterbury.
2496. ORDNANCE, T. Nordenfelt, Westminster.
2497. PROJECTILES, C. A. McEvoy, London.
2498. DOOR FASTENERS, A. M. Clark.—(*C. A. Crongeyer, U.S., and G. W. Busch, Canada.*)

*26th May*, 1882.

2499. DRILLING METALS, A. Higginson, Liverpool.
2500. HEELS for BOOTS, E. A. Brydges.—(*M. Rachler, G. Henneberg and I. Rothziegel, Vienna.*)
2501. INSULATOR, B. Rhodes & G. Binswanger, London.
2502. LOOMS, W. Mould and T. Grimshaw, Preston.
2503. LEADS, G. Daubenspeck, London.
2504. VELOCIPEDES, J. Simonton, Comber.
2505. AXLE-BOXES, H. Simon.—(*La Société Anonyme des Ateliers de la Dyle, Louvain.*)
2506. LAMPS, A. M. Silber, London.
2507. HOT-PLATE, A. J. Boult.—(*L. Bracco, Troyes.*)
2508. SCREW THREADS, J. Johnson.—(*W. Forbes, U.S.*)
2509. AERIAL NAVIGATION, A. J. Boult.—(*A. Werner, Magdeburg.*)
2510. STAY LACES, A. W. L. Reddie.—(*La Société Industrielle des Tresses et Lacets de St. Chamond, Paris.*)
2511. CARRIAGES, S. Andrews, Cardiff.
2512. ELECTRIC LAMPS, E. W. Beckingsale, Chiswick.
2513. FASTENINGS, F. Tew, London.
2514. SIGNALLING, J. White, Bermondsey.
2515. HAY-MAKING MACHINES, S. H. Dening, Chard.
2516. INSULATION, G. S. Page, Stanley, U.S.
2517. FUSEL OIL, J. K. Field.—(*H. Ujhely, Vienna.*)
2518. INSULATION, G. S. Page, Stanley, U.S.

*27th May*, 1882.

2519. AIR EXHAUSTING APPARATUS, W. Akester, Glasgow.
2520. BREAKING COKE, H. J. H. Thomas and J. Somerville, Surrey.
2521. LIFTS, J. Day, W. Green & H. Walker, London.
2522. WASHING MACHINES, M. & T. Staveley, York.
2523. DYEING, J. Mewburn.—(*L. Nouvelet and L. Fay, France.*)
2524. BUFFER, W. R. S. Jones, Ajmere, India.
2525. FELT HATS, J. C. Bramall, Woodley, and W. G. Bywater and J. Teale, Holbeck.
2526. DYNAMO MACHINES, W. Lake.—(*J. J. Wood, U.S.*)
2527. GAS, H. Davey, Leeds.
2528. FANS, R. A. Lister and G. Richmond, Dursley.
2529. DIGGING MACHINES, W. Doubleday, Chelmsford.
2530. STOVES, H. Ransford, Brighton.
2531. ARMATURES, W. R. Lake.—(*J. J. Wood, U.S.*)
2532. DIELECTRICS, E. W. Beckingsale, Chiswick.
2533. PONTOON DOCKS, R. Turnbull, South Shields.
2534. DRYING FELTS, T. Aitken, Helmshore.
2535. LOOMS, H. Lomax, Darwen.
2536. CUTLERY, H. and G. Taylor, Sheffield.
2537. GUNPOWDER, W. Lake.—(*H. Gruson, Germany.*)
2538. CARRIAGES, T. Horrex, London.
2539. HANGING BASKETS, E. W. Warsop, Bristol.
2540. FURNACES, G. F. Janes, London.

## Inventions Protected for Six Months on Deposit of Complete Specifications.

2388. COMBING WOOL, C. D. Abel, Southampton-buildings, London.—A communication from F. C. Glaser, Berlin.—*20th May*, 1882.
2399. SEWING MACHINES, A. A. Fisher, San Francisco.—*22nd May*, 1882.
2416. ELECTRIC BATTERIES, H. H. Lake, Southampton-buildings, London.—A communication from J. B. Wallace, Ansonia, U.S.—*22nd May*, 1882.
2429. WATER METERS, B. D. Healey, Brighouse.—*23rd May*, 1882.
2430. CALCINING KILNS, J. T. Raynes, Llysfaen, and B. D. Healey, Brighouse.—*23rd May*, 1882.
2470. ALARM CLOCKS, W. R. Lake, Southampton-buildings, London.—A communication from Jerome and Co. (Incorporated), New Haven, U.S.—*24th May*, 1882.
2479. STOPPERS for BOTTLES, J. S. Davison, Sunderland. —*25th May*, 1882.

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

2038. TRIP MOTIONS, J. Edge, Bolton-le-Moors.—*22nd May*, 1879.
2063. SLIDING VALVES, P. Everitt, Great Ryburgh.—*23rd May*, 1879.
2065. MORTISING CHISEL, H. Stent, Stratford.—*23rd May*, 1879.
2067. SETTING SAW-TEETH, J. Trickett, Newark-upon-Trent.—*23rd May*, 1879.
2093. GRAPPLE BUCKETS, T. Hodge, Kingston-upon-Hull.—*26th May*, 1879.
2481. TRANSMISSION APPARATUS, J. Hopkinson, London.—*21st June*, 1879.
2079. COVERINGS for CARRIAGES, G. W. von Nawrocki, Berlin.—*24th May*, 1879.
2092. STEAM ENGINES, S. Starkey, Lincoln.—*26th May*, 1879.
2094. FLOUR, &c., J. Higginbottom and E. Hutchinson, Liverpool.—*26th May*, 1879.
2137. FILTRATION of WATER, G. Bischof, London.—*29th May*, 1879.
2164. TRICYCLES, E. C. F. Otto, Peckham.—*31st May*, 1879.
2121. AUTOMATIC CLUTCH, C. J. B. Ward, London.—*28th May*, 1879.
2127. DRESSING FLOUR, J. Ellison, Leeds.—*28th May*, 1879.
2321. ELECTRICITY, J. D. F. Andrews, Charlton.—*11th June*, 1879.
2113. ATTACHING SHEET ZINC, C. F. Henwood, London. —*27th May*, 1879.
2138. STEAM ENGINES, F. C. Marshall, Newcastle-on-Tyne.—*29th May*, 1879.
2158. SCREW CUTTING APPARATUS, W. J. McCormack, Paignton.—*30th May*, 1879.

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

1714. SODA, J. Mactear, Glasgow.—*8th May*, 1875.
1957. DATE STAMPS, J. E. Massey, London.—*28th May*, 1875.
1955. PURIFICATION of GAS, G. T. Livesey, Surrey.—*28th May*, 1875.
1911. SCOURING WHEAT, &c., J. Higginbottom and E. Hutchinson, Liverpool.—*25th May*, 1875.
1912. FURNACE BARS, T. S. Dobson, Nottingham.—*25th May*, 1875.
1931. BRAKE APPARATUS, O. G. Bolitho, Cornwall.—*26th May*, 1875.
1938. INSULATING COMPOUNDS, F. Field, Lambeth, and R. Talling, Cornwall.—*27th May*, 1875.
2017. FILTERS, J. F. Crease, Eastney.—*2nd June*, 1875.

## Notices of Intention to Proceed with Applications.

*Last day for filing opposition 16th June*, 1882.

293. HOOK FASTENER, J. McKenny, West Dublin.—*20th January*, 1882.
330. WOVEN WIRE MATTRESSES, J. Foley, Dublin.—*23rd January*, 1882.
341. HAND STAMPS, G. K. Cooke, London.—*23rd January*, 1882.
356. ARRESTING PROGRESS of SHIPS, A. Reddie, London. —Com. from J. McAdams.—*24th January*, 1882.
362. GAS ENGINES, F. W. Turner, St. Alban's.—*24th January*, 1882.
390. TERRETS, W. R. Lake, London.—A communication from E. W. Johnson.—*26th January*, 1882.
415. VELOCIPEDES, W. Hillman, Coventry.—*27th January*, 1882.
431. AUTOMATIC LATHES, F. Wirth, Germany.—Com. from G. and E. Heyne.—*27th January*, 1882.
510. SLIPPING BOOTS from LASTS, G. Jenkins, Kingswood.—*2nd February*, 1882.
515. SILVERING GLASS, J. E. Pratt, Camberwell.—*6th February*, 1882.
574. PREVENTING INCRUSTATION in BOILERS, J. Pover, Liverpool.—*6th February*, 1882.
740. ELECTRIC LAMPS, A. M. Clark, London —A communication from Solignac and Company.—*15th February*, 1882.
798. RECOVERING SODA, H. C. F. Störmer, Paris.—*18th February*, 1882.
863. DRAWING IN WARP THREADS, J. H. Johnson, London.—Com. from L. S. Sherman, R. H. Ingersoll, and G. Moore.—*22nd February*, 1882.
907. PENDULUM MOTOR APPARATUS, W. R. Lake, London.—Com. from J. von Zách.—*24th February*, 1882.
925. EARTH CLOSETS, W. H. Lascelles, London.—*25th February*, 1882.
929. HYGROMETER, L. Boye, London.—*25th February*, 1882.
989. LOCKING DEVICES, C. Bolle, Berlin.—*1st March*, 1882.
1171. BURNING of CARBON ELECTRODES, A. Graham, Camberwell.—*10th March*, 1882.
1569. CLOSING DEVICES for BOTTLES, Count W. von Schlieffen, Germany.—*31st March*, 1882.
1640. DYNAMO-ELECTRIC MACHINE, R. Kennedy, Glasgow.—*4th April*, 1882.
1668. SUBMARINE TORPEDOES, W. N. Hutchinson, Wellesbourne.—*6th April*, 1882.
2075. CALORIC ENGINES, J. Buckett, Southwark.—*2nd May*, 1882.
2430. CALCINING KILNS, J. T. Raynes, Peny-y-Bryn, and B. D. Healey, Brighouse.—*23rd May*, 1882.

*Last day for filing opposition*, 20*th June*, 1882.

5239. HAYMAKING MACHINES, W. N. Nicholson and W. Mather, Nottingham.—*30th November*, 1881.
371. PRINTING MACHINES, T. G. and J. Dawson, Otley. —*25th January*, 1882.
375. CATTLE FOOD, C. D. Abel, London.—A communication from O. Zucker.—*25th January*, 1882.
376. PIANO ORGANS, C. D. Abel, London.—Com. from C. Donadoni and Pohl.—*25th January*, 1882.
381. DISINFECTANTS, E. G. Brewer, London.—A communication from E. E. Egasse.—*25th January*, 1882.
386. CORES, W. T. Henley, Plaistow.—*26th January*, 1882.
407. SAVING LIFE at SEA, W. Fewster, Margate.—*26th January*, 1882.
429. FEEDING WOOL, W. Cliffe and T. Ainley, Golcar, and J. Shaw, Huddersfield.—*27th January*, 1882.
430. ROVING MACHINERY, W. R. Lake, London.—A communication from W. E. Whitehead and A. T. Atherton.—*27th January*, 1882.
435. GUN WADS, H. E. Newton, London.—Com. from De Condé, Schmid, & Du Houx.—*28th January*, 1882.
445. FIRE-GRATES, J. Jaffrey, Manchester.—*28th January*, 1882.
460. PAPER PULP, E. Bauman, Budapesth.—*30th January*, 1882.
463. TANNING HIDES, W. R. Lake, London.—A communication from C. Vanderstraeten.—*30th January*, 1882.
469. BOILERS, J. Parkinson, Caton.—*31st January*, 1882.
472. DYNAMIC COOLING, H. E. Newton, London.—A communication from L. Allen.—*31st January*, 1882.
489. ELECTRICAL BATTERIES, G. Skrivanoff, Anerley-grove, Surrey.—*31st January*, 1882.
492. LOOMS, R. S. and E. Collinge, Oldham.—Partly communication from R. Collinge.—*1st February*, 1882.
505. DRESSING STONE, J. D. Brunton, London.—A communication from F. H. J. Trier.—*1st February*, 1882.
514. BLAST FURNACES, J. Brown, London.—*2nd February*, 1882.
516. SPRINGS, F. Wirth, Germany.—A communication from J. A. Widemann.—*2nd February*, 1882.
517. SADDLES, W. R. Lake, London.—A communication from F. G. Burley.—*2nd February*, 1882.
521. CIGARETTES, R. Wallwork, Manchester.—*3rd February*, 1882.
540. DYNAMO-ELECTRIC MACHINES, J. D. F. Andrews, Lanarkshire.—*3rd February*, 1882.
553. METALLIC CASES, T. R. Bayliss, Northfield.—*4th February*, 1882.
559. PRINTING TELEGRAPH APPARATUS, W. R. Lake, London.—A communication from La Société Secondo Roos and F. Ostrogovitch.—*4th February*, 1882.
594. WASHING MACHINES, H. L. Wilson and J. Clegg, Accrington.—*7th February*, 1882.
601. RIBBED FABRICS, C. H. Openshaw and C. H. Rothwell, Bury.—*8th February*, 1882.
633. ANTI-CORROSIVE WRAPPINGS, A. Riegelman, Prussia.—*9th February*, 1882.
639. ECONOMISING FUEL, J. W. Wood and J. Greenwood, Oldham.—*10th February*, 1882.
665. INJECTING APPARATUS, H. A. Bonneville, London. —Com. from J. A. Joltrain.—*11th February*, 1882.
804. PRESERVATIVE COMPOSITIONS for SHIPS' BOTTOMS, W. C. A. Holzapfel, Newcastle-upon-Tyne.—*18th February*, 1882.
823. HOLDING PAINT, W. R. Lake, London.—Com. from F. R. Grout.—*20th February*, 1882.
977. STAPLE, W. R. Lake, London.—A communication from G. Smith.—*28th February*, 1882.
1058. ALUMINIUM, J. Morris, Uddingston.—*4th March*, 1882.
1231. GRINDING MILLS, L. Gathmann, Chicago, U.S.— —*14th March*, 1882.
1415. SHIPS' RUDDERS, Sir J. E. Commerell, London. —*23rd March*, 1882.
1430. OBTAINING POWER upon SHIPS, A. M. Clark, London.—Com. from K. Anunsen.—*24th March*, 1882.
1529. NON-CONDUCTORS, T. and J. Brooke, Sheffield.— *29th March*, 1882.
1633. DRIVING GEAR, H. Clegg, Accrington.—*4th April*, 1882.
1762. WIRE, J. Westgarth, Warrington.—*13th April*, 1882.
1820. SAVING LIFE in COLLIERIES, D. R. Jones, Carmarthen.—*17th April*, 1882.
2041. BOOTS, T. J. Handford, London.—A communication from H. C. Gros.—*29th April*, 1882.
2083. LUGGAGE LABELS, C. Keith, Inverness.—*3rd May*, 1882.
2095. FIRE-LIGHTERS, J. Templeman, London, and T. Carmichael, Glasgow.—*4th May*, 1882.
2130. ARMOUR-PLATES, A. Wilson, Sheffield.—*5th May*, 1882.
2137. REVOLVING HARROWS, E. Button, Stanway.—*6th May*, 1882.
2145. CABINETS or CASES, A. Black, Paisley.—*6th May*, 1882.
2168. FILTERS, G. Macaulay-Cruikshank, Glasgow.— A communication from H. C. Rice.—*9th May*, 1882.
2174. TRICYCLES, C. Harvey and W. Paddock, Birmingham.—*9th May*, 1882.
2178. COLOURING MATTERS, J. A. Dixon, Glasgow.—A communication from Farbwerke vorm. Meister, Lucius, and Brüning.—*9th May*, 1882.
2232. GENERATING ELECTRIC CURRENTS, J. M. Stuart, London.—*11th May*, 1882.
2250. CASKS or BARRELS, S. Wright, Liverpool.—*12th May*, 1882.
2374. SPOOLS, W. R. Lake, London.—A communication from J. M. Parker.—*19th May*, 1882.
2388. COMBING WOOL, C. D. Abel, London.—A communication from F. C. Glaser.—*20th May*, 1882.
2399. SEWING MACHINES, A. A. Fisher, San Francisco, U.S.—*22nd May*, 1882.
2416. ELECTRIC BATTERIES, H. H. Lake, London.—A communication from J. Wallace.—*22nd May*, 1882.
2470. ALARM CLOCKS, W. R. Lake, London.—A communication from Jerome and Co.—*24th May*, 1882.

## Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 26th May*, 1882.)

2439. PREPARING MOSS PEAT, F. Versmann, New Charlton.—*2nd June*, 1881.
3896. SPINNING, &c., YARNS, W. Lancaster, Accrington, and E. Slater, Burnley.—*8th September*, 1881.
5093. TRAVERSE MOTIONS, T. White, jun., Leeds.— *22nd November*, 1881.
5185. ELECTRIC LAMPS, E. G. Brewer, London.—*28th November*, 1881.
5190. SECURING KNOBS to HANDLES, G. Harper, London. —*28th November*, 1881.
5204. STOP COCKS, C. Stuart, Fenny Stratford.—*29th November*, 1881.
5205. DRILLING APPARATUS, C. Stuart, Fenny Stratford.—*29th November*, 1881.
5211. SEWING MACHINES, J. Hunt and J. S. Fairfax, London.—*29th November*, 1881.
5212. ANIMAL CHARCOAL, T. Hadfield, Liverpool.—*29th November*, 1881.
5218. SPINNING, &c., F. W. Fox, Windhill, Yorkshire. —*29th November*, 1881.
5227. RINGS, &c., J. V. Hope, Wednesbury.—*30th November*, 1881.
5228. CONSTRUCTING DAMS, J. Thomas, Bangor.—*30th November*, 1881.
5232. HEATING APPARATUS, W. Hutchinson, Clapton Park.—*30th November*, 1881.
5243. BURNERS of OIL LAMPS, W. Foxcroft, Birmingham, and J. Titley, Wolverhampton.—*30th November*, 1881.
5247. WHEEL PADS, J. F. Walters, London.—*30th November*, 1881.
5250. HARROWS, J. Elkington, London.—*30th November*, 1881.
5266. RECEIVING APPARATUS, A. M. Clark, London.— *1st December*, 1881.
5288. WARDROBES, &c., E. Peyton, Birmingham.—*3rd December*, 1881.
5325. STEAM BOILERS, H. Sharp, Bolton.—*6th December*, 1881.
5338. SECONDARY BATTERIES, D. G. FitzGerald, C. H. W. Biggs, and W. W. Beaumont, London.—*6th December*, 1881.
5358. WHEELS and AXLE-BOXES, W. R. Lake, London. —*7th December*, 1881.
5381. WATER-CLOSET APPARATUS, D. Gill, Weston-super-Mare.—*9th December*, 1881.
5477. ELECTRIC LAMPS, W. R. Lake, London.—*14th December*, 1881.
5538. FIRE-ARMS, T. Nordenfelt, London.—*17th December*, 1881.
5593. DYNAMO-ELECTRIC MACHINES, L. S. Powell, Notting-hill, London.—*21st December*, 1881.
5594. KNITTING MACHINES, B. J. B. Mills, London.— *21st December*, 1881.
5601. ELECTRICAL BRUSHES, J. N. Aronson, London.— *21st December*, 1881.
397. GAS ENGINES, C. Emmet, Leeds.—*26th January* 1882.
986. DYNAMO-ELECTRIC MACHINES, W. H. Akester, and T. B. Barnes, Glasgow.—*1st March*, 1882.
1112. PROTECTING HARBOURS, J. Shields, Perth.—*8th March*, 1882.
1230. ELEVATORS or LIFTS, P. M. Justice, London.— *14th March*, 1882.
1465. CARBONS, A. Smith, Brockley.—*27th March*, 1882.

(*List of Letters Patent which passed the Great Seal on the 30th May*, 1882.)

4780. ELECTRIC CONDUCTORS, A. T. Woodward, New York, U.S.—*1st November*, 1881.
5060. PREVENTING ACCIDENTS in HOISTS, S. Empsall, Halifax.—*19th November*, 1881.
5253. TRICYCLES, I. T. Townsend, Coventry.—*1st December*, 1881.
5258. RINGS, J. W. Merrall, Morton.—*1st December*, 1881.
5274. INSECT POWDER, A. C. Henderson, London.—*2nd December*, 1881.
5287. VELOCIPEDES, C. Beger, Berlin.—*3rd December*, 1881.
5297. BLACKING LEATHER, H. H. Lake, London.—*3rd December*, 1881.
5307. OIL, &c., J. Darling, Glasgow.—*5th December*, 1881.
5316. LIGHTING RAILWAY CARRIAGES, R. Laybourne, Newport.—*5th December*, 1881.
5320. HATS, &c., R. Wallwork, Manchester.—*6th December*, 1881.
5327. RIVET PEG, J. Hewitt, Leicester.—*6th December*, 1881.
5332. PRINTING MACHINES, J. J. Allen, Halifax.—*6th December*, 1881.
5372. PAPER BAGS, F. D. Bumstead, Hednesford.—*8th December*, 1881.
5378. LOOMS, W. H., E., and J. Smith, Kidderminster. —*9th December*, 1881.
5382. AUTOMATICALLY LIGHTING GAS, F. Wirth, Germany.—*9th December*, 1881.
5388. CUTTING LOAF SUGAR, J. M. Day, W. R. Green, and H. C. Walker, London.—*9th December*, 1881.
5437. COUNTERS for MULES, D. and F. H. Orme, Oldham.—*13th December*, 1881.
5447. GLOVE FASTENING, J. Hinks, T. Hooper, and F. R. Baker, Birmingham.—*13th December*, 1881.
5451. SECONDARY BATTERIES, J. Pitkin, Clerkenwell. —*13th December*, 1881.
5452. ELECTRICAL BATTERIES, W. R. Lake, London.— *13th December*, 1881.
5455. SCREW PROPELLERS, J. Taylor, Birkenhead.—*14th December*, 1881.
5536. DYNAMO-ELECTRIC MACHINES, J. E. H. Gordon, Kensington.—*17th December*, 1881.
5608. BOXES, &c., W. R. Lake, London. — *22nd December*, 1881.
5617. CYANURETS or CYANIDES of METALS, J. H. Johnson, London.—*22nd December*, 1881.
5667. COLLECTING ELECTRIC CURRENTS, S. A. Varley, Hatfield.—*24th December*, 1881.
79. VEHICLE AXLES, C. Pieper, Berlin.—*6th January*, 1882.
619. EXPLOSIVES, W. F. Reid, Stowmarket, and D Johnson, Chester.—*8th February*, 1882.
624. DRAW BAR, &c., S. Humble and J. Walker, Derby. —*9th February*, 1882.
655. EXCAVATING STONY MATERIALS, P. W. D'Alton, London.—*10th February*, 1882.
712. CARTRIDGE MAGAZINES, G. E. Vaughan, London. —*14th February*, 1882.
985. LIGHTING GAS by ELECTRICITY, C. L. Clark and J Leigh, Manchester.—*1st March*, 1882.
990. CHECKING APPARATUS, G. F. Redfern, London.— —*1st March*, 1882.
1094. SOCKETS, E. H. Johnson, London.—*7th March*, 1882.
1108. SAFETY PINS, W. R. Lake, London.—*7th March*, 1882.
1150. HOLDING LAWN TENNIS NETS, J. Osmond, Kent. —*9th March*, 1882.
1259. WEAVING TAPE LADDERS, J. Carr, Manchester.— —*15th March*, 1882.
1377. OBTAINING AMMONIA, W. Young, Peebles, and G. T. Beilby, Midcalder.—*21st March*, 1882.
1451. CIGARETTE PAPERS, A. G. Goodes, London.—*25th March*, 1882.
1503. CLEANING COTTON, A. M. Clark, London.—*28th March*, 1882.
1515. STEAM MOTORS, W. R. Rowan, London.—*29th March*, 1882.
1636. MAGAZINE FIRE-ARMS, W. R. Lake, London.—*4th April*, 1882.

## List of Specifications published during the week ending May 27th, 1882.

4102, 6d.; 4388, 6d.; 4400, 6d.; 4425, 6d.; 4433, 6d.; 4516, 4d.; 4524, 6d.; 4542, 4d.; 4545, 8d.; 4558, 6d.; 4559, 6d.; 4568, 2d.; 4571, 6d.; 4577, 6d.; 4578, 10d.; 4595, 4d.; 4596, 6d.; 4600, 6d.; 4604, 6d.; 4606, 6d.; 4608, 6d.; 4613, 6d.; 4618, 4d.; 4620, 4d.; 4626, 6d.; 4629, 6d.; 4631, 6d.; 4636, 8d.; 4637, 6d.; 4640, 6d.; 4643, 2d.; 4645, 2d.; 4647, 2d.; 4648, 2d.; 4650, 2d.; 4651, 2d.; 4653, 2d.; 4655, 6d.; 4656, 2d.; 4657, 2d.; 4659, 6d.; 4661, 2d.; 4662, 6d.; 4663, 6d.; 4664, 2d.; 4665, 2d.; 4666, 6d.; 4667, 2d.; 4669, 6d.; 4674, 2d.; 4676, 6d.; 4677, 6d.; 4680, 2d.; 4684, 6d.; 4685, 4d.; 4687, 4d.; 4688, 6d.; 4689, 2d.; 4692, 2d.; 4693, 2d.; 4694, 2d.; 4695, 8d.; 4696, 6d.; 4698, 2d.; 4699, 6d.; 4700, 6d.; 4701, 8d.; 4702, 2d.; 4704, 6d.; 4706, 2d.; 4709, 2d.; 4711, 4d.; 4712, 4d.; 4713, 2d.; 4715, 6d.; 4717, 10d.; 4719, 2d.; 4723, 8d.; 4724, 6d.; 4725, 6d.; 4727, 2d.; 4728, 4d.; 4734, 6d.; 4738, 2d.; 4739, 4d.; 4747, 6d.; 4749, 6d.; 4751, 2d.; 4754, 2d.; 4755, 2d.; 4756, 6d.; 4762, 4d.; 4763, 6d.; 4775, 4d.; 4808, 8d.; 4853, 8d.; 4864, 6d.; 5084, 6d.; 5435, 6d.; 616, 6d.

*** 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.*

4102. WINDOW SASHES and FRAMES, &c., *A. Bedborough, Westminster.*—*23rd September*, 1881. 6*d.*

This relates, First, to means of ventilation, and consists in forming a chamber above the window frame, the top sash being extended to fit into such chamber; and Secondly, to causing the sashes to pivot on the pulley stiles, so that they may be turned with the outside inwards for cleaning, repairing, &c.

4388. RAPIDLY EXTRACTING CALORIC FROM, OR COMMUNICATING IT TO LIQUIDS OR FLUIDS DURING THEIR UTILISATION IN CYLINDERS, *C. Tellier, Paris.*—*8th October*, 1881. 6*d.*

This relates to the use of chains connected to the piston, and to the ends of the cylinder, and which are heated by the fluid employed, while heaped up together; but which, when they are spread out in the cylinder, keep up the temperature of the fluid.

4400. PADS FOR THE FEET OF HORSES, *W. Reynolds, Oxford-street.*—*10th October*, 1881. 6*d.*

Elastic pads to enter recesses in the shoe are formed on the inner surface of spongy rubber, so as to render it more soft and elastic, and better adapted to protect the frog of the horse's foot. The pad is perforated to allow of free ventilation, and the under surface is chequered so that it may pick up and retain grit from the road, and thus give a better foot-hold.

4425. HEATING ROOMS, GREENHOUSES, &c., *T. Stokoe, near Leeds.*—*11th October*, 1881. 6*d.*

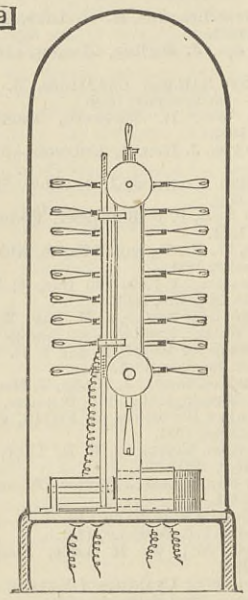
A series of hot-air tubes are placed one over the other and communicate with a chamber heated by a gas flame. They are enclosed by other tubes filled with water, and communicating with a boiler surrounding the heating chamber.

4433. CABLE-TRACTION STREET RAILWAYS, &c., *A. M. Clark, London.*—(*A communication from C. W. Rasmusen, Chicago, U.S.*)—11*th October*, 1881. 6*d*.

This relates to street railways in which the cars are propelled by endless travelling wire ropes arranged in a tube laid between the running rails, and it consists in means for locking the cars to the ropes and releasing them when required. Two ropes are employed, running side by side, and supported by a cross shaft running on wheels. On the axle of the car are spoke wheels, which project down through a slot in the tube and engage with the ropes.

4439. IMPROVEMENTS IN INCANDESCENT ELECTRIC LAMPS, *J. Jameson, Newcastle-on-Tyne.*—12*th October*, 1881. 6*d*.

The inventor mounts a set of carbons on a series of bars fitted on an endless band, operated by an electro-magnet placed inside the globe, which, when contact is made, attracts an armature and thereby gives motion to worm wheels keyed on the spindle of the rollers carrying the endless band. The figure explains



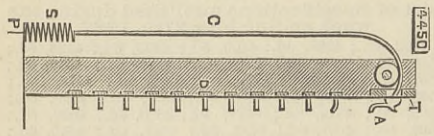

the invention. The top carbon only is in circuit. The inventor also provides a means for cleaning the inside of the lamp without destroying the vacuum. He places a pad with an iron core in the interior, and so arranges that it can be passed up into the interior of the lamp and made to touch the glass; it is then caused to rub the surface by the attraction of a strong magnet held outside.

4448. IMPROVEMENTS IN ELECTRO-MAGNETS FOR TELEPHONIC AND OTHER PURPOSES, *J. Imray, London.*—12*th October*, 1881.—(*A communication from J. M. Stearns, jun., Brooklyn, New York.*) 6*d*.

This invention relates to the construction and adjustment of the astatic cores of electro-magnets in such a manner that their armatures are attracted, whatever be the direction of the currents through their coils. When no adjustment is required for the astatic core, it consists of a simple bar magnet bent at its middle so as to bring its two opposite poles nearly together. These are then near their extremities enclosed within a coil of insulated wire; currents of either direction will then attract an armature presented to the poles. The inventor claims the above as applied to telephonic purposes.

4450. AN IMPROVED METHOD AND APPARATUS FOR EFFECTING TELEPHONIC COMMUNICATIONS, *J. Imray, London.*—12*th October*, 1881.—(*A communication from J. M. Stearns, jun., Brooklyn, New York.*) 6*d*.

This invention relates to an arrangement of the line wires and their connections at the exchange, so as to facilitate the making and breaking telephonic connections. The figure shows a section of a switch-board. Wire P at back of board is attached to spring S, and




continued upwards in a flexible conductor C, passing over a pulley at top and attached to metal ring A, having a collar by which the strain of S is pulled against insulated metal bar T, and is in electrical contact therewith. D D, &c., are insulated metal bars in front of board with metal hooks, on which ring A can be hooked. Bar T is connected through a call and telephone receiver to battery, D being in connection with subscribers' lines. To connect two subscribers two rings A are pulled down and hooked on to same bar D.

4454. IMPROVEMENTS IN INSTRUMENTS FOR MEASURING ELECTRIC CURRENTS, PARTLY APPLICABLE TO THERMOMETRIC REGULATORS, *J. T. Sprague, Birmingham.*—12*th October*, 1881. 6*d*.

This refers to improvements on the inventor's patent No. 4762 (1878). First, as regards the galvanometer therein described, in which the needles were of soft iron magnetised by the current itself. The inventor now obtains a more perfect magnetism in the needles by employing a part of the current for magnetising purposes, and the rest as usual for deflection. The invention also refers to improvements on the inventor's instrument for registering the quantity of currents which have passed, consisting of an electro-depositing cell with reversing commutator and a recording apparatus actuated by the weight of metal transferred by the current. The improvement consists in the use of a moving electrode, the weight of which is supported by flotation, so that it may rise and sink in the liquid by the change of specific gravity due to the deposit or removal of metal. The electrode is made hollow or provided with floats and fitted with a stem, so that the normal weight of the electrode just immerses the lower part of the stem, while the immersion of the stem just equipoises the metal as added. Various other methods of carrying out the invention are described and illustrated, together with reversing commutators, shunts adjusted to vary in resistance as the meter circuit varies, and a heater and thermo-regulator for controlling the temperature.

4472. A NEW OR IMPROVED ELECTRIC METER OR APPARATUS FOR MEASURING AND REGISTERING THE QUANTITY OF ELECTRICITY PASSED THROUGH A CONDUCTOR, *C. V. Boys, Wing, near Oakham.*—13*th October*, 1881. 6*d*.

This relates to a method for measuring and registering the quantity of electricity passed through a conductor, by means of clockwork with an escapement governed by a pendulum or balance, the oscillations of which are determined by the force of an electro-magnet having its coil in the electrical circuit, so that according as a less or greater quantity of electricity passes through the circuit, the amount of movement permitted to the clockwork is less or greater. A counter connected to the clockwork shows by suitable indices the quantity of electricity that has passed in a given time. The specification is accompanied by drawings of the meter.

4516. BOTTLES AND VESSELS FOR CONTAINING EFFERVESCING BEVERAGES, &c., *B. Azulay, Islington.*—17*th October*, 1881. 4*d*.

This consists in making the bottle in two parts, one to receive the acid and the other the alkali, so that the two may be poured out and mixed as required.

4524. COLLECTING AND REMOVING THE DUST PRODUCED IN CARDING FLAX, HEMP, &c., *F. W. Borland, France.*—17*th October*, 1881. 6*d*.

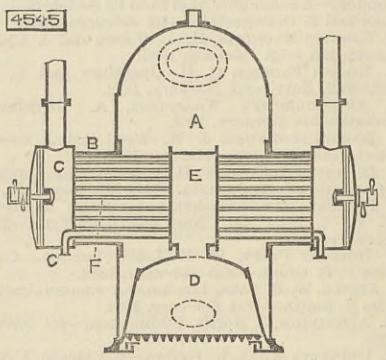
This consists in applying a special ventilating arrangement to carding engines, and constructing them so that the dust will be carried to the outside of the mill during the carding operation. The periphery of the card cylinder and its rollers from the top down to the floor is encased, and the body of the cylinder is connected with an air chamber fitted with an exhaust fan.

4542. VELOCIPEDES, *F. W. Eické, Surrey.*—18*th October*, 1881. 4*d*.

The object is to lessen the labour in riding over hills, and consists in mounting on the wheels or axles at any convenient point, and at a greater or less distance from the centre of rotation, flasked-shaped vessels or accelerators containing mercury.

4545. STEAM BOILERS, *G. Hill, Liverpool.*—18*th October*, 1881. 8*d*.

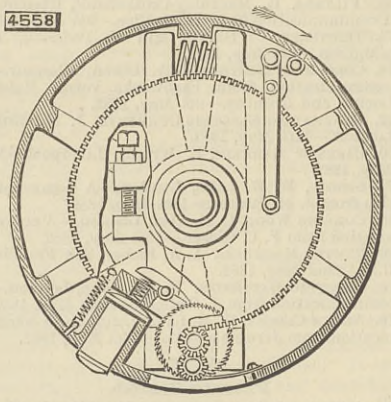
The object is to provide a steam boiler with a large steam generating surface in a small compass, and in which brickwork can be dispensed with, and that can always be readily examined. The main part of the boiler consists of a vertical shell A with egg or dome-shaped top, to either side of which is attached a cylin-




drical continuation B, to the outer end of which the smoke-box C is applied. The fire-box D is arranged below the barrel-shaped sides of the boiler, with a combustion chamber E leading to the top of it, and from either side tubes F lead to the smoke-boxes C and carry off the products of combustion. A tube G leads a current of air into the combustion chamber above the fire-box, which is preferably made taper and fitted with a curved top.

4558. IMPROVEMENTS IN OR APPLICABLE TO REGISTERING DYNAMOMETERS, &c., *W. P. Thompson, Liverpool and London.*—19*th October*, 1881.—(*A communication from the Transmitting Dynamometer Company, New York.*) 6*d*.

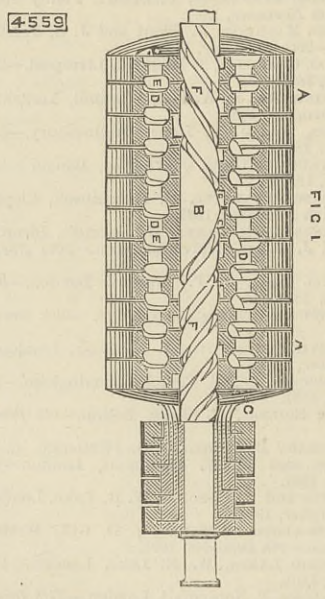
The invention consists in applying to a pulley a rotating dial plate which joins in the rotating movement of the pulley, but has an independent rotation movement of its own either slightly faster or slower than that of the pulley, and in placing against the said dial a pencil, which is fitted into a jointed arm capable of vibratory movement, so that the variations of pressure imparted to a spring or springs by an arm or



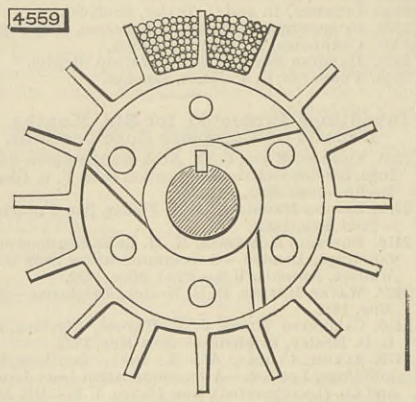

arms transmitting the movement of the shaft to the pulley, or *vice versâ*, will control the movement of the said pencil-holder and cause it to mark on the dial the varying positions of said pencil, the pencil-holder revolving with the pulley. The dial plate has an independent movement, however, and by the differential speed between the pencil-holder and the dial one is enabled to make progressive lines on the dial, indicating the variations of power transmitted. The figure will show how this is done.

4559. IMPROVEMENTS IN APPARATUS FOR GENERATING AND UTILISING ELECTRICITY, *F. M. Newton, Boston Grange, near Taunton.*—19*th October*, 1881. 6*d*.

This invention relates to a dynamo machine and arc




lamp. The figures show the mode of construction of the armature of the machine. It is formed of a number of cast iron discs A, wider at their bosses C than elsewhere, thus leaving a space between each for air circulation. Each disc is pierced with holes D and provided with wings E to cause the circulation of air drawn in through D and helical grooves F F in shaft B. Each disc is provided with a series of grooves, in which eight coils of insulated wires are wound, so as to form four circuits. Fig. 1 shows the construction of the commutator, Fig. 2 being a section of the armature. With regard to the lamp the inventor claims the use for regulating the field of an electrode of a



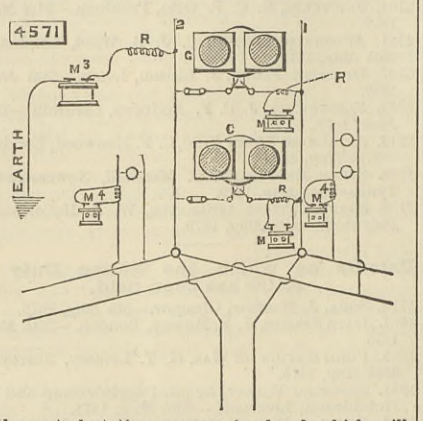

roller, in conjunction with an inclined surface in a moving part controlled by a magnet and a fixed arm, the arrangement being such that when the moving part controlled by the magnet moves beyond a certain point the roller is forced by the arm out of contact with the electrode, and the latter is liberated.

4568. COMBINING DOOR CHAINS WITH LOCKS, LATCHES, &c., *H. Skerrett, Birmingham.*—19*th October*, 1881.—(*Not proceeded with.*) 2*d*.

The bolt of the lock is formed with a hook-like recess, and the chain is connected at one end to the staple-box of the lock, and the free end has a hook to engage with the recess in the bolt.

4571. IMPROVEMENTS IN THE MEASUREMENT OF ELECTRICITY IN DISTRIBUTION SYSTEMS, *E. G. Brewer, London.*—19*th October*, 1881.—(*A communication from T. A. Edison, Menlo Park, U.S.*) 6*d*.

The object of this invention is to furnish a means for determining the aggregate consumption of electricity in a distribution system from the central station where no individual meters are employed, or for ascertaining at the central station the correctness of the total consumption shown by all the house meters, so as to compare the meter accounts, and also at the same time to determine the amount of leakage.




At the central station a meter is placed which will give the total current generated by the dynamo and thrown into the main circuit, and also a meter for recording the total leakage, the difference between the records of the two being the total amount consumed. The figure shows the method of connecting up the meters, &c.; 1 and 2 are main conductors, G G dynamos; M M are current meters, and $M^3$ leakage meter, $M^4$ being house meters, and R resistances to shunt only a definite proportion of the current through the meters.

4577. TREATMENT OF IRON FOR THE REMOVAL THEREFROM OF PHOSPHORUS, SULPHUR, &c., *P. Jensen, London.*—19*th October*, 1881.—(*A communication from Count de Montblanc and L. Gaulard, Paris.*) 6*d*.

This consists, First, in the application of water steam saturated with a hydro-carburet for the elimination of metalloids contained in molten iron; and Secondly, in a special form of apparatus for producing and applying such steam saturated with a hydro-carburet.

4578. SELF-FEEDING, BASE-BURNING, AIR-HEATING AND VENTILATING STOVES, *W. A. Barlow, London.*—19*th October*, 1881.—(*A communication from F. Lonholdt, Frankfort.*) 10*d*.

These stoves are on the principle of the American stoves with uninterrupted firing, but with improvements consisting in a mantle or double casing, a very effective mode of ventilation, and a combination of smoke draughts, so that the heat can be utilised for cooking purposes without making the stove look unsightly.

4587. PLAITING MACHINES, *J. Dowling, London.*—20*th October*, 1881. 6*d*.

This relates to plaiting machines with a reciprocating knife, and consists, First, in the application of the knife to a rocking shaft mounted on frames and driven by an excentric and rod from the driving shaft. The rocking shaft has a slotted arm extending down, and to it the rod is attached, so as to be capable of adjustment to vary the width of the plait; Secondly, a friction clutch and two rollers for pressing the material are employed; Thirdly, a lever is attached to the knife to cause the knife to give the necessary pressure on the material, the lever being driven by an excentric on the driving shaft; Fourthly, two rocking shafts and knives, placed one over the other, may be used, and the material be made to pass between them, so as to form a box plait or a double box plait.

4593. CLEANING GRITS PRODUCED FROM CORN, GRAIN, &c., *A. Besser, Vienna.*—20*th October*, 1881. 6*d*.

A chest of wood has apertures to observe the process, and to it the grit is introduced through a hopper in a continuous and uniformly divided stream, which drops from one to the other of a series of chambers communicating by slots through the bottom of each, the material being acted upon as it falls by a current of air, so that the lighter portions are carried over fixed or adjustable prisms, and fall downwards through a second series of chambers, being again acted upon by a current of air. Suitable discharge openings are formed at the bottom of the case.

4595. SASH FASTENERS, *J. G. Chillingworth, London.*—20*th October*, 1881. 4*d*.

This consists of a hinged part secured to the lower rail of the upper sash, and which when turned down fits on to the top rail of the bottom sash, on which a sliding bolt is fitted, and serves to secure the hinged part.

4596. WASHING BOTTLES, *J. J. Harvey, Kidderminster.*—20*th October*, 1881. 6*d*.

The object is to effectually cleanse the interior of bottles by agitating them when charged with water and gravel, stone, or shot. A frame carrying a receptacle for the bottles at each end is mounted on a shaft and caused to swing or rock rapidly.

4598. WATER-CLOSETS, *G. Pitt, Sutton.*—20*th October*, 1881.—(*A communication from Dr. J. Finck, Baden-Baden.*) 6*d*.

The object is to render closets absolutely inodorous, and to prevent them being centres of infection in houses. The soil pipe descends into a chamber filled with water to a level to cover the end of the pipe to a depth of from 5 to 15 c.m., an overflow being provided at the top end of the chamber. The bottom of the chamber is inclined, and the exit opening is fitted with a stopper, which, when removed, allows the contents of the chamber to escape to a conduit leading to a drain, cesspool, or receiver.

4599. FOOD FOR HORSES, CATTLE, &c., *J. H. Cox, Matlock.*—20*th October*, 1881. 4*d*.

This relates to the manufacture of a condensed food, consisting of an admixture of grains with condiments and other substances in certain proportions, which mixture is formed into a paste and compressed into blocks or cakes, which are then baked.

4600. VELOCIPEDES, *G. Singer, Coventry.*—20*th October*, 1881. 6*d*.

This relates, First, to an improved pedal, by means of which the parts on which the foot rests are raised clear of the parts through which the spindle passes; and Secondly, to an improved form of detachable handle rod chiefly applicable to bicycles, and especially applicable where the handle rod is required to be curved, and consisting in forming the rod in two or more pieces screwed together after being bent as required.

4601. ORNAMENTING OR EMBELLISHING GLASS, &c., *J. W. Savage, Fulham-road.*—20*th October*, 1881. 2*d*.

The design is painted in ordinary oil colour on one side of the sheet of glass, and when dry is coated with a glutinous and saccharine body, in which colours of the desired tints have been mixed. The coating, when dry, has a layer of oil colour or varnish applied to represent the soft shades, and to blend with the previous colours, when the whole is protected by a backing of cement, air-proof and water-proof.

4602. BREECH-LOADING FIRE-ARMS, *H. E. Newton, London.*—20*th October*, 1881.—(*A communication from the Colt's Patent Fire-arms Manufacturing Company, Incorporated, Hartford, U.S.*)—(*Not proceeded with.*) 2*d*.

In breakdown guns the hammers are cocked by tilting the barrels to open the breech. In breech-cylinder fire-arms the axial motion of the breech cylinder is checked by fitting the "gate" on its inner edge with a tooth, which extends into the path of the ratchet teeth on the end of the breech cylinder, and acts as a yielding stop to the progress of the cylinder.

4603. FIRE-GRATES, *Captain T. E. Clarke, Minehead.*—20*th October*, 1881. 6*d*.

The grate is open and the smoke is made to pass down through the fire and up through two side tubes to the smoke-box above the fireplace and then to the chimney. Air can circulate round the grate so as to be heated before entering the room.

4604. FINISHING CORN IN THRASHING MACHINES, *E. Foden, Chester.*—21*st October*, 1881. 6*d*.

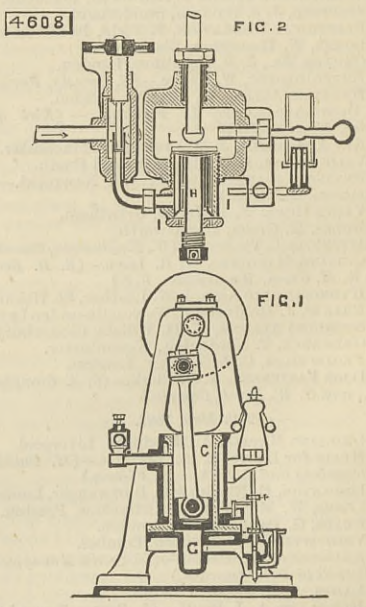
This relates to the method of separating chaff and other light substances from grain in thrashing machines, and also for separating or sorting the light from the heavier grain. Instead of employing riddles or sieves mechanically agitated or working in conjunction with a blast, a fan is used, in combination with a creeper and vertical pipe, through which the grain and chaff fall after passing through a scourer or screen, and meeting the draught from the fan, the light grain and other light particles are carried with the current to the fan, while the heavy grain descends into an ordinary separator. Air inlets are formed in the vertical pipe, and the fan is formed with a sliding valve to regulate the air pressure. The ribbed lining of the scourer is made in two parts, capable of reversal.

4606. TEA, *J. C. Marillier, Nice.*—21*st October*, 1881. 6*d*.

The leaves of the tea plant have the necessary degree of withering imparted to them regularly and rapidly by placing them in a special air-tight chamber composed of galvanised iron plates, and closed on all sides except at front, where it is fitted with a door fitting air-tight. Trays are formed in the chamber to receive the leave and a partial vacuum is caused in such chamber an causes the leaves to wither.

4608. GAS ENGINES, *W. Watson, Leeds.*—21*st October*, 1881 6d

The cylinder C provided with piston and rod is attached to a framework, and below it is a chamber G to receive the explosive gases prior to explosion, the gas and air being admitted thereto by an arrangement shown in Fig. 2, and consisting of a central tube H, within a tube I, the air being caused to pass through




small holes so as to divide it, and thereby effect a more perfect mixture. The igniting arrangement is similar to that described in patents No. 1723, A.D. 1881, and No. 2919, A.D. 1881. A valve L is fitted over the inlet for the gas and air, and the cylinder is provided with a water jacket.

4609. VENTILATING, HEATING, AND COOLING, *J. Court, Brompton-road.*—21*st October*, 1881.—(*Not proceeded with.*) 2*d*.

A shaft rises above the top of the building, and contains a flue formed with pipes to serve as a chimney for the kitchen or other fire which is in constant use, a space being left between the chimney and the inside of the shaft which communicates with the place to be ventilated. By these means a strong up draught is caused in the shaft.

4610. DOOR LOCKS, *J. Mathisen, Norway.*—21*st October*, 1881.—(*Not proceeded with.*) 2*d*.

When using metal latches they are made hollow at the front, and a conical pin is placed thereon to secure the latch by means of a screw thread. The axle is round and enclosed in a tube fastened to the partitions of the lock, the axle being rigidly connected to a bolt arm working between two shoulders in the lock. The bolt arm acts on an intermediate lever with two projections, one taking into a hole in the bolt arm and the other into a hole in the bolt. The intermediate lever

is fitted with a projecting pin guided in the partition and surrounded by a spring to support the latch when at rest. On the lower side of the bolt is a recess to receive another pin and spring serving to shut the lock when the door is slammed.

4613. LOOMS FOR THE MANUFACTURE OF CUT PILE FABRICS, *W. Hanson, near Bradford.*—21*st October*, 1881. 6*d.*

This relates to pile fabrics in which two pieces of the fabric are woven together face to face, being connected by the pile, which is afterwards cut by knives, and it relates to means for regulating the letting in of the pile warp and the tension upon the warps in looms for manufacturing such fabrics.

4614. TREATING AND UTILISING FIBROUS PEAT, &c., *J. A. London, London.*—21*st October*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to a means of treating fibrous peat so as render it suitable for use as a substitute for straw as litter for horses and other animals.

4615. FASTENER FOR WAIST-BELTS, STRAPS, CLOAKS, &c., *L. Dee, Golden-square.*—21*st October*, 1881. 6*d.*

This consists of a tube attached to the article, and formed with inclined grooves in the interior to receive pins projecting from a plug working within the tube. The end to be fastened is passed under the bottom of the tube, and the plug when turned is caused to bear on it and secure it in position.

4616. DRYING AGRICULTURAL PRODUCE, *M. E. G. Finch-Hatton and R. Thorpe, Lincolnshire.*—21*st October*, 1881. 8*d.*

This relates to the construction and arrangement of apparatus to dry agricultural produce by currents of heated air acting on the same while it is agitated, and it consists in the combination on one vehicle of furnaces and flues for heating the air, and a fan for blowing it along, with a steam boiler and engine for working the fan and the drying apparatus.

4618. PREVENTING THE PURLOINING OF LETTERS FROM LETTER-BOXES, *G. Nobes.*—21*st October*, 1881. 4*d.*

A balanced guard plate or valve is fitted within and forms the underside of the shoot of the letter-box, so that it yields to permit the insertion of letters, but tilts into a position to close the shoot when weight comes on its lower edge, which may be serrated to catch any cord dropped into the box to abstract letters. A number of claws hang loosely across the opening in the shoot below the valve, and are pivotted so as to yield and allow letters to pass, but prevent their withdrawal.

4620. CISTERN VALVES, *H. T. Dawson, Chiswick.*—21*st October*, 1881. 4*d.*

A chamber is adapted to screw on to a nipple at the end of the supply pipe, the upper part serving as an air vessel, and the chamber also contains a glass or other ball valve. The water outlet is at the bottom, and is surrounded by an india-rubber ring to form a seat for the ball valve. The float lever is pivotted to the chamber, and its rear end is curved up so as to bear against and lift the ball valve from its seat as the float falls.

4621. DEVICE TO BE USED AS A REEL OR SPOOL FOR HOLDING THREADS, *F. Wirth, Germany.*—21*st October*, 1881.—(*A communication from P. Adt, III., P. Adt, jun., and J. B. and E. Adt, Germany and France.*) 4*d.*

A piece of cardboard is formed with central semi-circular depression, the middle one being on one side of the axis of main body, and the end ones on the opposite side. Side depressions of semicircular form are also made in the card. The card thus made can be used on sewing machines.

4626. CRUSHING AND TREATING AURIFEROUS AND OTHER MINERAL ORES, *C. J. Appleby, London.*—22*nd October*, 1881. 6*d.*

This consists, First, of a battery of stamps driven by means of chain wheels and endless chains from a steam engine; Secondly, of a novel construction of amalgamating boxes, into which the pulverised quartz flows from the stamps, and the gold in it is extracted by means of mercury; Thirdly, of novel methods of constructing and arranging the parts or buddles of concentrating apparatus, in which the gold remaining in the pulverised quartz flowing from the amalgamating boxes is concentrated; and Fourthly, in the general arrangement of the machinery employed.

4629. GLAND STUFFING-BOXES FOR WATER AND STEAM, &c., *J. G. Stidder, Surrey.*—22*nd October*, 1881. 6*d.*

As applied to water valves, this consists of a loose internal stuffing-box or receptacle for packing, which, when filled with packing material suitably compressed, is inserted into the outer or usual stuffing-box, its lower part pressing upon a flexible ring in the bottom of the outer stuffing-box, so that the gland cover, on being screwed down, forms a tight joint.

4630. WIRE FENCES, *F. C. Guilleaume, Cologne.*—22*nd October*, 1881. 6*d.*

So as to close the entrance openings of fences, the ends of the line wires are attached to a vertical and portable spindle, the lower end of which is tapered so as to insert it in its bearing, and also to force it into the ground when required to leave the entrance open. The permanent standard to which the wire gate is to be secured is formed with an eye at bottom and a hook at top to receive the portable spindle, which carries a ratchet, with which a pawl on the top hook engages. To secure the line wires to the standards, the latter are formed with slots, and the wires are inserted in staples, the ends of which are then passed through the slots and turned back.

4631. FURNITURE VANS, &c., *H. Mousell, Gloucester, and O. Lythgoe, Manchester.*—22*nd October*, 1881. 6*d.*

The van consists of four sections: First, it forms a trolley with lock-up well beneath to convey pictures, plate, or pier glasses, &c.; Secondly, a van body is made to fit on the trolley; Thirdly, a small trolley body only is used to convey loose goods, and is covered with a tarpaulin top; and the Fourth section is constructed of parts screwed together, so as to be easily attached to or detached from the first section by hooks, eyes, hinges, and staples, and when put together it forms a complete furniture van, which will travel on railways.

4632. IMPROVEMENTS IN THE CONSTRUCTION OF SECONDARY BATTERIES, *J. S. Sellon, London.*—22*nd October*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to a method of constructing secondary batteries by the use of peroxide of lead, or other metallic oxide, packed upon or round pieces of metal, such metal being used in the form of gauze, perforated or corrugated, and fixed to frames of wood; sheets of a porous material are then packed around the oxides. Thin sheets of lead are attached to one or both sides of the element.

4633. SHIPS' DAVITS, &c., *R. B. U. H. J. Duncan.*—22*nd October*, 1881.—(*Not proceeded with.*) 2*d.*

Ships' davits are made with a single stem or column carrying two or more heads springing from the top, the davit being fixed in the ordinary manner, and by turning it the boat is swung out ready for lowering. Special means for disengaging the boat when lowered are described.

4634. COMPOSITION FOR USE IN CARPENTRY, FIREPROOFING, &c., *A. M. Clark, London.*—22*nd October*, 1881.—(*A communication from C. C. Gilman, Eldora, U.S.*) 4*d.*

This relates to the manufacture of a material which is indestructible by fire, acids, and gases, is a poor conductor of heat, electricity, possesses molecular and capillary attraction, and is workable with edged tools, and it consists of 1 part kaolin clay free from grit, from 1 to 3 parts resinous sawdust, and sufficient water to thoroughly incorporate the above by aid of machinery into a plastic mass.

4635. TREATMENT OF ORES AND METALLIC COMPOUNDS OR RESIDUAL PRODUCTS CONTAINING SILVER, LEAD, OR COPPER, &c., *F. M. Lyte.*—22*nd October*, 1881. 4*d.*

This relates to improvements on patent No. 2807, A.D. 1877. The operation is carried on in an oven or reverberatory furnace, the ore being first calcined or not, and then in the state of a fine powder mixed with any suitable chloride, preferably salt, and placed in the furnace in a vessel lined with brick and there treated with sulphuric acid, gentle firing being employed to complete the volatilisation of the antimonious or other volatile chlorides. The fumes are conducted to a chimney or a suitable condenser, from which the chloride of antimony may be collected and metallic antimony extracted. Compounds containing copper and nickel with other metals capable of forming volatile chlorides may also be treated in this manner.

4636. PASTEBOARD MATCH-BOX, *A. M. Clark, London.*—22*nd October*, 1881.—(*A communication from La Société Anonyme de l'Imprimerie Marseillaise, Marseilles.*) 8*d.*

This consists, First, in the form of the pasteboard blank, whereby the box is rendered sufficiently strong to retain its shape without the use of stiffening pieces; Secondly, in the method of rendering the lid self-closing without the use of an india-rubber spring. An inner box is caused to slide within an outer case, and when drawn out it causes the top lid to be bent backwards, and when released the elasticity of the lid forces the inner box within the case again.

4637. ROTARY APPARATUS, *A. J. Boult, London.*—22*nd October*, 1881.—(*A communication from L. B. Villebonnet, Nancy, France.*) 6*d.*

As applied to a pump, this consists of a cylinder enclosing two wings mounted on a shaft passing through the cylinder, motion being imparted to the wings by an arrangement of four bars or links forming a jointed quadrilateral. Two of the links are shorter than the others, and the latter are coupled close to the cylinder, while the former are coupled and attached to the periphery of a wheel driven by any suitable means, and the centre of which is in a line bisecting the angle formed by the two short links, and on the line which connects the point in which the short links meet with the meeting point of the long links. The wings are placed in the cylinder so as to form the same angle as that formed by the links, one wing being fast on the shaft and the other pivotted thereon.

4639. SEWING MACHINES, *T. B. Giffen and J. Dold, Glasgow.*—22*nd October*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to button hole machines, and consists, First, in cutting the hole in the cloth before being sewn; and Secondly, in lengthening the carrying feed plate to the front of the machine and jointing another plate to its under side, such plate being hinged so as to close on to and secure the fabric.

4640. ROASTING, GRINDING, AND MIXING COFFEE, &c., *J. Parnall, Bristol.*—22*nd October*, 1881. 6*d.*

A cylinder has a series of tubes inserted in it to convey heat to the interior, and also to carry off vapours arising during the process of roasting. An outer case surrounds the drum and has outlets leading to a ventilating chamber to carry off the products of combustion and vapour. The heat is obtained by the combustion of a mixture of gas and air. A grinding mill is fitted with magnets to prevent the passage of nails to the interior. The mixing apparatus consists of a drum provided at each end with a spiral worm, gradually diminishing in diameter as they approach the centre of the drum, where they intersect.

4642. VACUUM BRAKE APPARATUS, *J. Gresham, Salford.*—24*th October*, 1881. 6*d.*

This relates to apparatus for indicating when the brake apparatus is in working order as described in patent No. 4801, A.D. 1881, and consists in pressure measuring apparatus to indicate whether the small partial vacuum kept up in a pipe connected with the train pipe is in existence and fully operative on the train pipe.

4643. STORING AND DISPLAYING BOOTS, &c., *S. B. Goodwin and W. Barsby, Leicester.*—24*th October*, 1881.—(*Not proceeded with.*) 2*d.*

A central pillar supported by a circular foot has frames radiating from it, and fitted with hooks to carry the boots or shoes.

4645. CUTTING PROFILES IN THREE, FOUR, OR MORE-SIDED OBJECTS, &c., *T. Morgan, London.*—24*th October*, 1881.—(*A communication from E. Bhan, near Berlin.*)—(*Not proceeded with.*) 2*d.*

This relates to machines for shaping rough pieces of wood into finely profiled pillars, &c. The rough pieces or bars are arranged in a kind of endless bed which leads them slowly past revolving cutters, the bars being clamped so that they can be turned to 90 deg., so as to offer a second side to the cutters when they pass again. The bed consists of two endless chains running over wheels.

4646. BOTTLES FOR AERATED OR GASEOUS LIQUIDS, *C. M. Warner, Lambeth.*—24*th October*, 1881. 6*d.*

This relates to bottles with internal ball stoppers, and consists of means to prevent the liquid coming in contact with the rubber washer. The neck of the bottle is screw threaded internally to receive a metal cap with a central hole through it, and containing a top washer of india-rubber and a bottom washer of cork. The bottle below the neck is formed with a rectangular shoulder, so as to prevent the return of the ball into the neck while pouring out the liquid.

4647. TWIN SCREW SHIPS OR VESSELS, *T. R. Oswald, Southampton.*—24*th October*, 1881.—(*Not proceeded with.*) 2*d.*

The vessel at the lower part is formed with a double tail and apertures and rudders, the two portions being joined together below the deck line by a single upper stern forming a continuation of the hull. The object is to increase the speed and efficiency of vessels propelled by a pair of screw propellers and to reduce vibration.

4648. TILES, *H. J. Haddan, Kensington.*—24*th October*, 1881.—(*A communication from A. Vuillaumé, France.*) 2*d.*

This relates to the shape of the tile, which is rhombical, and is placed in a diagonal position on the slope of the roof.

4650. MANUFACTURE OF SHIRTS, &c., *J. W. Frost, London.*—24*th October*, 1881.—(*Not proceeded with.*) 2*d.*

The object of the invention is to afford the advantage of a reversible front and cuffs to a shirt, or of a reversible front to a false front.

4651. SYSTEM OF SUSPENSION FOR BEDS AND SEATS TO PREVENT SEA-SICKNESS ON BOARD OF SHIPS, *F. Lebacq, Brussels.*—24*th October*, 1881.—(*Not proceeded with*) 2*d.*

The inventor claims mechanism placed above boxes, which prevents the bed from following the movements or the rolling of the ship, this bed being suspended in a cone on a movable rundle of india-rubber, which causes the bed to remain always in a perpendicular position, notwithstanding the movements or motion of the ship. Other mechanism placed in the boxes prevents the effects of the pitching by maintaining always at the same level the bottom of the interior box, which supports the whole system.

4652. SHIPS' SLEEPING BERTHS, *W. R. Lake, London.*—24*th October*, 1881.—(*A communication from D. Parkes, Boston, U.S.*) 6*d.*

This consists mainly of a berth, the frame of which is suspended upon its longitudinal axis, so that it has no end play, while the bottom is suspended upon its transverse axis and from the frame, the result being that the frame can be made very nearly as long as the distance between the bulkheads of the state room, and yet ample provision be made for causing the berth to remain horizontal, notwithstanding the rolling and pitching of the vessel.

4653. WIRE FENCING, *H. P. Deane, Bath.*—24*th October*, 1881.—(*Not proceeded with.*) 2*d.*

Metal uprights are employed which are notched to receive the wires upon a projecting flange or edge, and each notch is also adapted to receive a transverse locking piece. When the wires have been placed in the notches the locking pieces are inserted to secure them.

4655. REGENERATIVE HOT-BLAST STOVES, *J. Hartley, Barrow-in-Furness.*—24*th October*, 1881. 6*d.*

This consists in dividing the body of the stove into two or more horizontal divisions or chambers, and arranging in the said divisions or chambers a packing or checquering of fire bricks separated into two or more sections or short chambers, each of the said sections or short chambers of the packing or checquering opening at both ends into dust chambers, which are used in combination with clearing holes and doors.

4656. MANUFACTURE OF GLASS TILES, &c., *T. H. Rees, Lambeth.*—25*th October*, 1881. 2*d.*

This relates to a method of making glass tiles, so that the ornament, picture, or decoration is protected by the glass on both sides, and also to the method of fixing glass or other tiles by a step or lap combined with a metal tag or tongue.

4657. COUPLING AND UNCOUPLING RAILWAY CARRIAGES, &c., *S. H. Ward, Manchester.*—25*th October*, 1881.—(*Not proceeded with.*) 2*d.*

Running across each end of the carriage, &c., is a bar or rod working in bearings connected to the framing, which bar or rod has a cranked arm at each end projecting over or under the buffers and extending to the outside of the vehicle. Attached to about the centre of this rod or bar, and capable of turning with it, is a link or coupling hook, so that when the rod or bar is turned from the outside of the vehicle by the crank arm, it raises the link and enables it to be dropped on a projecting hook on the opposite carriage, and so couple them together. To uncouple the vehicles the crank arm and rod is turned so as to raise the link and coupling hook attached to it from its detent in the projecting hook on the opposite carriage, when the hook or link is allowed to drop by its own weight and there remain attached to its bar or rod until again required for coupling up.

4659. IMPROVEMENTS IN LIGHTING BY GAS AND ELECTRICITY COMBINED, *R. H. Courtenay, London.*—25*th October*, 1881. 6*d.*

This consists in combining a strip of metal composed of an alloy of platinum and iridium—through which a current of electricity is made to pass—with a gas-burner, so that the former is heated by the latter, it being found that the heat from the burner effects a great saving in the work to be done by the current in producing a joint illumination, whilst the current produces more perfect combustion and more light from the gas.

4661. APPARATUS FOR FACILITATING THE ATTACHMENT OF HEELS TO BOOTS, SHOES, &c., *T. Lithgow, Manchester.*—25*th October*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to the arrangement and construction of apparatus whereby the heels of boots, shoes, and other similar articles may be clamped and secured in position upon the sole whilst being nailed or pegged thereto.

4662. APPARATUS FOR HEATING BATHS, &c., *E. P. Alexander, London.*—25*th October*, 1881.—(*A communication from C. Martin, Paris.*) 6*d.*

The boiler consists of three or more concentrically disposed compartments, which are connected to each other by horizontal and vertical pipes or tubes, so as to establish a constant and multiple communication between the several compartments.

4663. BURNERS FOR GAS STOVES FOR COOKING, &c., *E. P. Alexander, London.*—25*th October*, 1881.—(*A communication from C. Martin, Paris.*) 6*d.*

This consists in constructing the burners for gas stoves with movable perforated crowns or caps and special ducts or openings, allowing of the burners being more readily cleaned.

4664. IMPROVEMENTS IN ELECTROMETERS, *J. Imray, London.*—25*th October*, 1881.—(*A communication from J. Carpentier, Paris.*—(*Not proceeded with.*) 2*d.*

This relates to improvements in apparatus for measuring the relative intensity of two electric currents, and also for ascertaining under certain conditions their relative electromotive force, and for measuring resistance.

4665. DOORS AND WINDOWS, *H. J. Haddan, Kensington.*—25*th October*, 1881.—(*A communication from Favier-Simonet, Fourcoing, France.*)—(*Not proceeded with.*) 2*d.*

This relates to apparatus for rendering the bottom joints of windows, &c., hermetic, and preventing all air and water ingress.

4666. MINCING MEAT, &c., *C. M. Sombart, Magdeburg, Germany.*—25*th October*, 1881.—(*A communication from C. Hammer, sen., and H. Perschmann, Brunswick, Germany.*) 6*d.*

This consists in imparting to the chopping block a kind of planetary motion, that is to say, a rotary motion round its axis, which itself revolves on another axis.

4667. HORSESHOES, &c., *J. Vernon, Newton Stewart, Scotland.*—25*th October*, 1881.—(*Not proceeded with.*) 2*d.*

This consists partly in constructing a shoe having deep slots or sockets for the reception of removable plates or gripping surfaces furnished with dowels, which are secured in the sockets by transverse bolts or pins having split or forked ends to prevent their working out.

4669. BRAKES FOR WHEELED VEHICLES, *W. H. Marks, London.*—25*th October*, 1881. 6*d.*

This consists in the application of the brake between the spokes of one or more of the wheels or into slots the brake being worked by lever or handle, as may be convenient.

4674. STEAM BOILERS, &c., *C. Y. C. Dawbarn, Liverpool.*—25*th October*, 1881.—(*Not proceeded with.*) 2*d.*

This consists in taking the steam generated in the boiler and passing it through pipes which, in the form of a coil or other form, are placed along the crown of the furnace in the flues, or in any other suitable place where the heat can be applied, and thus use the full force of furnace for superheating the steam.

4676. WIRE ROPES, *J. Hodson, St. Helen's, Lancaster.*—25*th October*, 1881. 6*d.*

This consists in forming a core for the rope by coiling wire in the shape of a spiral spring—and a little larger than one of the outer strands of the rope—round which are wound preferably eight strands of the requisite size to give the thickness required.

4677. SCREW NUTS, &c., *W. H. Lewis and W. R. Clark, Surrey.*—25*th October*, 1881. 6*d.*

This consists partly in the construction of a nut with a projecting arm which shall prevent the said nut from turning when situated inside and within a moderate distance of the sides or bottom of a tank or cistern.

4680. APPARATUS FOR INDICATING AUTOMATICALLY THE PRESENCE OF FIRE DAMP, &c., *W. S. Macdonald, Manchester.*—26*th October*, 1881.—(*Not proceeded with.*) 2*d.*

A hollow globe is attached to one end of a beam or bar, and to the other end of the bar is attached a counterpoise; this bar is balanced on a fulcrum so that it remains in a horizontal position while the atmosphere is in its normal condition. The addition to the atmosphere of explosive gas, which is lighter than air, will cause the globe to fall, and the addition to the atmosphere of heavy gas will cause the globe to rise.

4681. FASTENER FOR SCARVES, &c., *H. Scott, Liverpool.*—26*th October*, 1881. 4*d.*

This consists of a hook or holder which slips between the head of the shirt stud or button and the shirt collar, such hook being provided with a spike which is inserted in the scarf. By this means the scarf is prevented from shifting.

4684. BALLOONS FOR ILLUMINATION, *F. C. Kinnear London.*—26*th October*, 1881. 6*d.*

This relates to the combination with a balloon of framework appliances for the purpose of displaying advertisement signals and other announcements by means of lamps carried thereby.

4685. HORSESHOES, *H. Dyer, London.*—26*th October*, 1881. 4*d.*

This consists of a horseshoe made of india-rubber, gutta-percha, leather, or other resilient or partially resilient material, and attached to a metal band, whereby the shoe may be secured to the hoof.

4687. ASBESTOS MATERIAL, *S. Pitt, Sutton.*—26*th October*, 1881.—(*A communication from H. W. Johns, New York.*) 4*d.*

This relates to a new article of manufacture made of asbestos fibre forced in a bat or mass, afterwards moistened and pressed into a solid and compact form.

4688. CASTER FOR CHAIRS, &c., *W. R. Lake, London.*—26*th October*, 1881.—(*A communication from A. F. Mauchain, Geneva.*) 6*d.*

This consists of an elastic caster for furniture in which the rod or spindle is supported and guided in a socket inserted in the leg of the piece of furniture, a spring being interposed between the end of the socket and the extremity of the rod or spindle.

4689. BREECH-LOADING FIRE-ARMS, *H. E. Newton, London.*—26*th October*, 1881.—(*A communication from the Colt Patent Fire-arms Manufacturing Company, Incorporated, Hartford, U.S.*)—(*Not proceeded with.*) 2*d.*

This relates to an improvement in revolvers with special reference to the lock mechanism, and to that class which is constructed so that the hammer may be thrown back and discharged by a single pull of the trigger or be cocked by hand and then released by the trigger.

4692. APPARATUS APPLICABLE TO DOORS AND WINDOWS FOR EXCLUDING DRAUGHTS, DUST, &c., *J. Benson and T. Wainwright, Southport.*—27*th October*, 1881.—(*Not proceeded with.*) 2*d.*

A board or plinth is constructed or made with a recess or groove, into which a lath or sliding piece is fitted. The said lath is attached to the board and held in position by a spring or springs, or by guides. A lever, cam, wedge, or like device is connected to the board, so as when moved to cause the lath to project from the surface of the board. When the lever or other device is unacted on, the spring or springs draw the lath into the recess or groove. A wood or metal rod is so arranged within the recess or groove, or in a subsidiary recess or groove, as to rest on or be attached to one end of the lever or like device. The other end of the said rod projects beyond the end of the board.

4693. APPARATUS FOR ELEVATING, PROPELLING, CONVEYING, &c., GRAIN, COAL, AND OTHER SUBSTANCES, *J. Woodward, Manchester.*—27*th October*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to arrangements or apparatus for elevating, propelling, and delivering or distributing grain, coal, salt, and various other substances, and consists in accomplishing this object by creating a partial vacuum, so as to produce a strong current of air through a pipe, channel, or passages through which the material is to pass to be conveyed to the required destination.

4694. IMPROVEMENTS IN APPARATUS FOR ACTUATING SIGNALLING APPARATUS ON RAILWAYS BY MEANS OF ELECTRICITY, *E. Edwards, London.*—27*th October*, 1881.—(*A communication from E. Lesbros, Valence, France.*)—(*Not proceeded with.*) 2*d.*

This relates to discs or other signals, the position of which can be varied as desired, used on railways, and actuated at a distance.

4695. IMPROVEMENTS IN THE METHOD OF AND MEANS FOR UTILISING ELECTRIC CIRCUITS FOR VARIOUS PURPOSES, SUCH AS TELEPHONIC OR TELEGRAPHIC COMMUNICATION, OR SYNCHRONISING TIME MEASURERS, &c., *W. F. Barrett, Monkstown, Dublin.*—27*th October*, 1881. 8*d.*

This invention relates to a method whereby a telegraph or telephone line may be used to keep clocks in unison, give notice of fires, &c. The inventor makes use of Ritchie's or other system of periodic time control from a central station, and adapts to the controlling and controlled clocks electric contacts, which the clock automatically closes and opens at certain times. During the day the controlling and controlled clocks each complete the circuit leading from the line wire to the telephonic or other apparatus, except for a short period, say ten to thirty seconds, when the circuit is broken by the clockwork, and by the same means the line placed in the clock controlling circuit. The normal clock is allowed then to regulate the controlled clock, and after a few seconds the line is again thrown into the previous telephone circuit. At night the line can be connected to fire or burglar alarms in this way, or utilised in other ways described in the specification.

4696. MAKING THE JOINTS OF PIPES, &c., *J. A. Eaton, London.*—27*th October*, 1881. 6*d.*

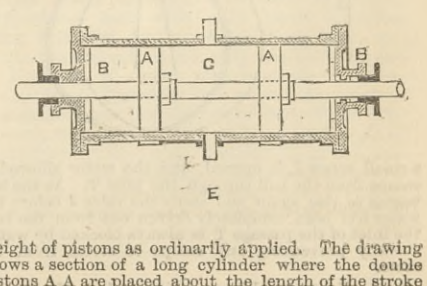
Loose sockets or collars are used in place of the usual sockets made on each pipe, and the joint is made with Spence's metal or Hutchinson's metalloid. The pipes have spigot ends, and over the butting ends is placed a socket formed with excentric holes at the ends and a larger concentric hole in the middle, so that while the top of the end holes rests on the pipe, the middle hole leaves a space to receive the molten material which is run in at the top. In the case of using sheet metal sockets, the ends are fitted with excentric discs capable of being turned so as to nearly close the ends.

4698. CHIMNEY CAPS, *R. Brealey, Westminster.*—27*th October*, 1881.—(*Not proceeded with.*) 2*d.*

The object is to form the caps so that the smoke can escape from whichever side the air current may come, and consists in forming two exits, one at the top and one at the base of the cap, the adjoining surfaces being so curved as to deflect the wind outwards, and thereby produce a suction on the products of combustion.

4700. STEAM ENGINES, *S. Geoghegan, Dublin, and J. Sturgeon, Westminster.*—27*th October*, 1881. 6*d.*

This relates, First, to a method of heating the steam cylinder by live steam applied internally, instead of in an external jacket in the manner hitherto usually employed; and Secondly, to a mode of balancing the




weight of pistons as ordinarily applied. The drawing shows a section of a long cylinder where the double pistons A A are placed about the length of the stroke apart. Steam is admitted at each end of the cylinder at B B, and exhausted in the ordinary way. The space C between the piston is always filled with live steam which enters at D. An outlet E is provided

with a cock to regulate the escape of any condensed water.

**4699.** MASHING AND PREPARING MAIZE, RICE, &c., FOR MASHING WITH MALT IN BREWING, *W. H. Apthorpe, Cambridge.—27th October*, 1881. 6*d*.

The raw grain to be treated is placed in a vat in which a vertical shaft carrying radial arms, rakes, or tines is caused to revolve and agitate the grain. The shaft is made hollow, and also carries a coil through which steam circulates and heats the contents of the vat.

**4701.** FISH HOOKS AND CROCHET HOOKS, *T. Morgan, Redditch.—27th October*, 1881. 8*d*.

This relates to machinery for barbing or bearding wire to make fish hooks or crochet hooks; and it consists of a hopper in which pieces of wire pointed at one end are placed, and are delivered one at a time into cross grooves in a feeding drum moving in a vertical plane, and to which an intermittent rotary motion is imparted. The ends of the wires project above the face of the drum, and when they reach the highest point of the drum's rotation during the rest, the wires are barbed by means of a grooved bed to support the pointed end of the wire, and which is carried to and fro over a slide over which works a holder to grip the pointed end on the bed. On the opposite side of the feeding drum is an oblique slide carrying a barbing cutter or tool.

**4702.** SULPHATE OF LIME, *J. Young, Renfrew, N.B.—27th October*, 1881. 2*d*.

To a solution of chloride of lime is added a solution of the sulphate of an alkali or earth, the result of the reaction being that sulphate of lime is precipitated, and the compound of chlorine and the alkali or earth remains in solution.

**4704.** CHANDELIERS OR SLIDING PENDANT LAMPS, *G. W. von Nawrocki, Berlin.—27th October*, 1881.—(*A communication from H. Raupp, Heilbronn, Germany.*) 6*d*.

The pendant consists of two vertical tubes united by a cross bar from which the smoke arrester is suspended, while the ends of the tubes are fitted with stuffing-boxes, through which slide the vertical rods of a frame joined by a cross bar at the lower end and carrying the lamp.

**4706.** KNIFE-BOARDS, *H. C. de Berenger.—27th October*, 1881. 2*d*.

The knife-board consists of a wooden board covered with leather, kamptulicon, or other tough substance, through which holes are punched and are afterwards filled in with emery or other cleansing or polishing powder.

**4709.** STOPPERING BOTTLES, *G. Kemp, Swinton, Yorks.—27th October*, 1881.—(*Not proceeded with.*) 2*d*.

The neck of the bottle is made taper and is of such a shape that the end of the cork abuts against a portion of the neck, so that the internal pressure is conducted against the side of the cork, which will be held firmly in place until partially withdrawn, when the pressure will act on the end of the cork and force it forward.

**4711.** FIGURED FABRICS, *J. Makin and J. E. Johnson-Ferguson, Bolton.—27th October*, 1881. 6*d*.

This relates to the manufacture of figured fabrics wherein a raised white figure is produced on a coloured ground, the colours being reversed at the back. The fabric is made with two shuttles, one carrying a coarse weft and the other a fine weft. It takes four picks to form the pattern. There are also two warps, one fine and one coarse.

**4712.** ASH PANS, *C. Ezard, Bradford.—27th October*, 1881. 4*d*.

The body of the screen of the ash pan is made entirely of cast iron with a curved moulding in front. The upper portion is flat, and slopes slightly forward, and has radiating apertures cast therein, through which when open the ashes fall into the pan. A curved slide of polished steel opens and closes the apertures in the screen.

**4713.** WEAVING CERTAIN FIGURED FABRICS, *J. Makin and J. E. Johnson-Ferguson, Bolton.—27th October*, 1881. 2*d*.

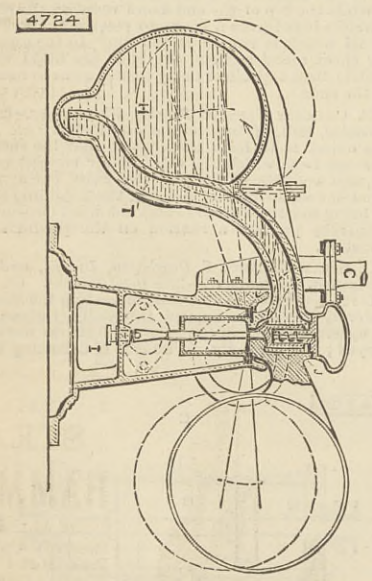
This relates to a method of weaving figured fabrics of the class described in patent No. 4711, A.D. 1881, the object being to produce the same with one shuttle only, and requiring three or more picks to make the pattern.

**4715.** WAX PAPER OR CLOTH, *W. R. Lake, London.—27th October*, 1881.—(*A communication from W. B. H. Dowse, Sherborn, Mass.*) 6*d*.

The object is to manufacture paper or cloth saturated with paraffine or a mixture of paraffine and resin, for the purpose of wrapping up and protecting all substances which are affected by atmospheric changes. The paper is fed from a roll, and passes through tension devices on its way to the pan containing the waxing solution. It also passes through equalising and compressing rolls, the lower one of which revolves in the heated wax.

**4724.** APPARATUS EMPLOYED TO DISCHARGE THE WATER OF CONDENSATION FROM STEAM PIPES, *H. G. Grant, Manchester.—28th October*, 1881.—(*A communication from E. Briart, Jeumont, France.*) 6*d*.

The apparatus comprises a metal ball H which is in constant communication with the steam conduit or receptacle by means of the pipe G. The water of condensation from the steam conduit or receptacle accumulates gradually in this ball, thereby increasing its weight and causing the lever which carries the ball to turn on its bearings. By this motion a little discharge valve J, the lift of which can be regulated by




a small screw I, is opened, and the water allowed to escape from the ball through the pipe T. As the ball begins to rise again and shuts the valve J before the water has been completely driven out from the ball, the inlet of the passage T is always blocked by water, thereby preventing any escape of steam from the same.

**4725.** FLUSHING WATER-CLOSETS, &c., *H. Skerrett, Birmingham.—28th October*, 1881. 6*d*.

The cistern has a capacity to contain about the quantity of water to be discharged at a time to the pan of the closet. In the cistern is a syphon formed in one piece therewith, the bend being preferably flattened out at top, in order to diminish the height which the water will require to rise to in the cistern. The flattened bend comes within a short distance of the top of the cistern, and it contains the same cubical capacity in cross section as that of the legs of the syphon; the short leg of the syphon opens into the cistern near the bottom, while the long leg passes through the bottom of the cistern to the closet pan. A displacer actuated by a lever descends into the cistern and effects the flushing.

**4727.** GENERATION AND APPLICATION OF WATER GAS, *P. Jensen, London.—28th October*, 1881.—(*A communication from the European Water Gas Company, Limited, Stockholm.*)—(*Not proceeded with.*) 2*d*.

The object is to utilise the waste heat of open hearth, cast steel, welding, puddling, and glass furnaces, while at the same time a considerably higher temperature than hitherto is maintained therein. The high temperature is obtained by the use of water gas.

**4728.** TUNNELLING AND EXCAVATING, *T. R. Crampton, Westminster.—28th October*, 1881. 4*d*.

At a distance from the working face in the open pumping machinery is provided to supply water at considerable pressure, which is led to the working face, and actuates an hydraulic motor which drives the excavating machine, and also mills or crusher, by which the *débris* is broken up or reduced, and mixing with the used water is discharged.

**4734.** COMBING COTTON, *P. C. Marsden and W. Pendlebury, Bolton.—29th October*, 1881. 6*d*.

The object is to increase the amount and improve the quality of the work done by combing machines, and it consists in increasing the diameter of the comb cylinders and providing two comb sections and two fluted sections for each cylinder. The combs in the comb section, instead of being all set at the same angle, are placed at different angles, the front comb being almost tangential to the circumference, while the angle of each succeeding comb gradually increases, so that the last comb of each section is at angle of about 60 deg. The cam which actuates the steel roller has a double set of grooves to correspond with the four sections, while the following cams are also made double-acting, viz., the leather roller cam, feed cam, top comb cam, and the nipping cam, by which means the whole of the combing process is performed twice at each revolution of the combing cylinder.

**4738.** APPLIANCES FOR USE WITH THE SHOES OF HORSES, &c., TO PREVENT SLIPPING, *G. W. Elliott, Liverpool, and A. E. Stayner, Sheffield.—29th October*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to appliances for use with horseshoes to prevent slipping, and it consists in forming the nails used to secure the shoes with a spiked head to project beyond the surface of the shoe.

**4739.** PEGS AND SCREWS FOR VIOLINS, &c., *J. Wallis, London.—29th October*, 1881. 4*d*.

The shank of the peg or screw is of metal, and passes through the sides of the head or scroll between which the strings are attached, the outer end passing freely through one side, while the other side is clipped by two collars mounted on the shank and capable of being tightened up by a screw nut sunk into the head of the peg, and mounted on the screwed end of the metal shank.

**4747.** WIGS, PERUKES, &c., *J. H. Johnson, London.—29th October*, 1881.—(*A communication from G. Petit, Paris.*) 6*d*.

This consists in forming wigs and other coverings for the head of hair (or imitation hair) interposed between two nets united together.

**4749.** SPRING BALANCES, *J. Linacre, Brecon, South Wales.—29th October*, 1881. 6*d*.

This relates to spring balances in which the weight is indicated by a pointer on a circular dial, and it consists in improvements in such balances adapted for weighing heavy bodies, such as coal, and whereby the sum or total weight of the several weighings is registered on the dial plate.

**4751.** HAND PERFORATING MACHINES, *L. A. R. Cler, Paris.—31st October*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to a perforating machine for copying and multiplying all kinds of drawings, and consists of a machine actuated by clockwork instead of by a pedal, and which is held in the hand and conducted as required.

**4754.** FENCES, GATES, &c., *D. Rowell, Westminster.—31st October*, 1881.—(*Not proceeded with.*) 2*d*.

The longitudinal rails are of tubular metal, and consist of two pieces of concave form joined together at the edges, and the uprights are either of wood or metal of any suitable section.

**4755.** ANCHORS, *F. H. F. Engel, Hamburg.—31st October*, 1881.—(*A communication from A. S. and A. Aggens, Germany.*)—(*Not proceeded with.*) 2*d*.

The object is to prevent the anchor stock being fouled by the cable, and also to increase the effectiveness of the anchor to turn on the ground and get hold of the bottom as soon as the cable is hauled home, and it consists in forming the stock of heart-shape, the anchor itself being constructed with one arm.

**4756.** DRAWING OFF AERATED BOTTLED LIQUIDS FROM BOTTLES HAVING INTERNAL STOPPERS, *S. Pitt, Sutton.—31st October*, 1881.—(*A communication from P. Hathaway, New York.*) 6*d*.

This relates to a stand for holding bottles containing aërated liquids, and it consists of a plug over which the mouth of the bottle is placed and which forces the internal stopper from its seat. The plug leads to a cock which allows the liquid to be drawn off as required. The base of the bottle, which is turned upwards, is supported by a cover which is pressed downwards by means of a pivotted lever of cam shape.

**4762.** PRODUCTION OF ENAMELS ON EARTHENWARE, GLASS, &c., *E. W. Heaton, Kent, and F. Bolas, Chiswick.—31st October*, 1881. 4*d*.

According to this invention one or more of the materials ordinarily used for producing vitrified enamels is mixed with a phosphorescent substance such as will, after exposure to light, remain luminous for some hours. Some of this mixture is placed on the object to be enamelled, after which it is exposed to a heat sufficient to melt the mixture.

**4763.** FOLDING PRINTED SHEETS OF PAPER. *W. Conquest, London.—31st October*, 1881. 6*d*.

The object is to make the action of the folding rollers in carrying off the printed sheets that are tucked into them by the folding blade more certain, and it consists in adapting to each roller two or more elastic rings which project above the surface of the roller, so that when the two rollers are in position their rings touch. The folding blade passes into the spaces between the rings, being cut away at the part where it would meet such rings, whereby the sheets are forced into the bite of the rings and are carried forward by them to receive the next fold or to be delivered.

**4775.** IMPROVEMENTS IN ELECTRIC LAMP, *H. A. Bonneville, Paris and London.—1st November*, 1881.—(*A communication from L. Daft, New York.*) 4*d*.

This consists in improvements in arc lamps, in which the upper carbon is regulated by being held in a tubular rod which is attached to the core of an electro-magnet by clips of platinum or porcelain. The carbon descends by gravity. The lower carbon is sustained in a tube containing mercury, which tends to force it up as it is consumed. This carbon is also supplied with regulating or detaining clips. The inventor also claims means for hanging lamps by elastic metallic suspension devices which also form part of the circuit of the lamp.

**4808.** BREECH-LOADING FIRE-ARMS, &c., *H. Simon, Manchester.—3rd November*, 1881.—(*A communication from F. Vetterli, Paris.*) 8*d*.

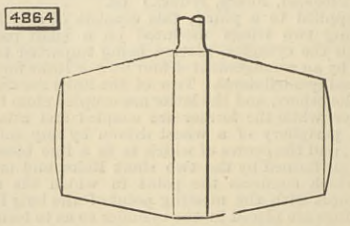
This relates to breech-loading fire-arms in which the breech is closed by a sliding bolt, and consists mainly in the application to such fire-arms of mechanism and devices whereby they are made to act as repeating rifles, supplying the cartridges from a magazine formed in the front part of the stock underneath the barrel, the invention being applicable to new and also to existing fire-arms.

**4853.** SHAPING METALS, *J. Whitehouse and S. Peacock, Birmingham.—5th November*, 1881. 8*d*.

This relates especially to machinery for shaping articles usually made by spinning, and it consists in fixing on a lathe spindle a chuck to hold the wide end of the roughly-shaped blank. On the bed of the lathe are three rolls having in longitudinal section the figure of the counter part of the article to be produced. The rolls are situated at nearly equidistant points round the axis of the blank to be operated upon, and are carried by supports capable of moving towards and from the axis of the lathe, being actuated by means of a right and left-handed screw worked by hand wheel. The rolls can also move in a direction parallel to the lathe axis.

**4864.** STEAM GENERATORS, *C. D. Abel, London.—7th November*, 1881. — (*A communication from H. Schulte, Austria.*) 6*d*.

This relates to "Tenbrink" boilers, in which a horizontal cylindrical chamber is connected by a branch on its top side with an upper cylindrical chamber, so that the steam rises from the former to the latter, the furnace being situated in a steeply inclined position within a correspondingly inclined transverse flue in the lower chamber, round the entire surface of which the flames and hot gases are made to play. In such




boilers a space extends the whole length of the top side of the lower chamber and is occupied by steam, so that the part of the boiler covering such space becomes rapidly burnt away by the flames passing over it, to obviate which such steam space is restricted to a comparatively small portion of the crown, one mode of effecting this being shown in the drawing, and consisting of making the shell larger in diameter at the middle than at the ends. If desired, the shell may be made largest at the ends, the steam rising to the highest part. The transverse flue containing the fire grate is made less inclined than usual, so that the top edge of the flue is some distance below the top of the crown and is always covered with water.

**5084.** BOTTLES, &c., *J. Pattison, Kennington.—21st November*, 1881. 6*d*.

In the neck a decreasing or tapering orifice leading to the inside of the bottle is formed, and has a screw thread to receive the stopper which is similarly formed. Above the threaded part is a recess to receive a cork or india-rubber washer, against which the under side of the stopper head bears.

**5435.** BREECH-LOADING CANNON, *R. H. Brandon, Paris.—13th December*, 1881.—(*A communication from B. B. Hotchkiss, Paris.—(Complete.*) 6*d*.

The object is, First, to produce by one single motion the opening of the breech, the extraction and ejection of the fired cartridge, and the cocking of the gun, and by another single motion the closing of the breech and the throwing of the trigger in gear, so that the gun is ready for firing; and it consists in the use of a long sliding breech block operated by the partial or complete rotation of a lever attached to the breech receiver, and connected to the block by a shaft and crank, provided with a stud working in a slot in the breech block; the motion of the lever is utilised for working the hammer and that of the block for working the extractor; Secondly, to provide convenient and steady means of directing and firing the gun, and consisting in attaching to the rear of the gun a shoulder piece or stock with handles for the left hand of the gunner, and a pistol grip, which is seized by the right hand, so as to enable him to use with steadiness his entire weight to direct the arm; Thirdly, to means for ejecting the fired cartridge and introducing a new one without interfering with the man who points and fires the gun, and consisting in providing the upper face of the horizontal arm of the stock with a bed or trough to guide cartridges to the chamber when the breech is open; an inclined aperture under the trough provides a free passage for the ejected cartridge.

**650.** VELOCIPEDES, *H. A. Dufrené, Paris.—10th February*, 1882.—(*A communication from A. Mange, France.*)—(*Complete.*) 4*d*.

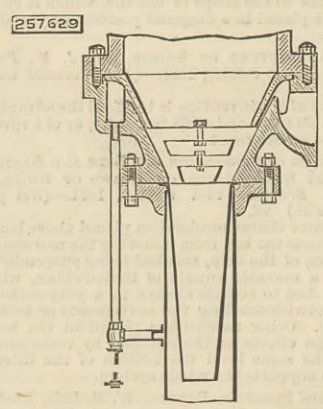
The object is to construct a velocipede so that the weight of the rider is utilised as motive power, and it consists of a forked frame carrying the driving wheel at one end, and forming bearings in the centre for a shaft, while the other end is provided with a socket in which turns the fork carrying the hind or steering wheel. The saddle is mounted on a rod which slides up and down, and is jointed to an arm on the central shaft, to which the treadles are also secured and connected to the driving wheel by rods.

## SELECTED AMERICAN PATENTS.

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

**257,629.** INJECTOR CONDENSER, *Jerome Wheelock, Worcester, Mass.—Filed 23rd January*, 1882.

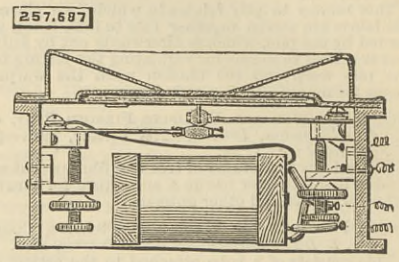
*Claim.*—(1) In an injector condenser, the combination, with the water chamber having an elevated annular lip, a cone projecting downward within said lip, of a conical shell extending below said cone and water chamber, and a discharge pipe connected to the




lower and small end of said conical shell, substantially as described. (2) The combination, with the water chamber in an injector condenser, of a sediment trap and a flush pipe, substantially as described. (3) The combination, with the conical main shell in an injector condenser and a discharge pipe connected to the lower end of said shell, of a tapered nozzle extending downwardly within said discharge pipe, and in communication at its upper end with the interior of the conical shell, substantially as described.

**257,687.** TELEPHONE TRANSMITTER, *James P. Freeman, Treat T. Prosser, and H. B. Prosser. Chicago, Ill., assignors to the Home Telephone Company, of Illinois.—Filed 22nd October*, 1880.

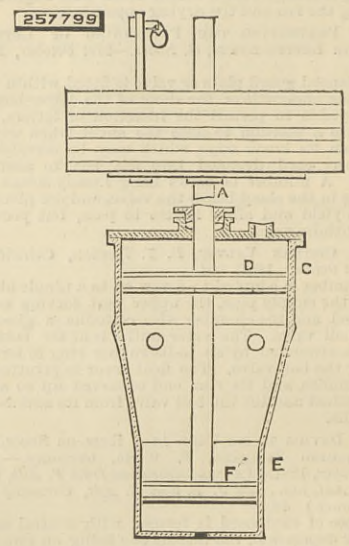
*Claim.*—(1) A tension regulator composed of a compressed compound of steel filings, coke, lamp-black, and balsam of fir, substantially as before specified. (2) The combination, substantially as before specified,




of the spring arm, the button secured in a ring thereof, and the platinum fail strips inserted between the button and its encircling ring. (3) The combination, substantially as before specified, of the spring arm carrying the button or tension regulator, the rigidly-secured but somewhat elastic non-conducting bracket supporting said arm, and the adjusting screw acting on said bracket.

**257,799.** REGULATOR FOR BLOWING ENGINES, *Thomas F. Witherbee, Port Henry, N.Y.—Filed 8th February*, 1882.

*Claim.*—A blast furnace blowing engine having an air cylinder C connecting with a blast pipe, a steam




cylinder E having piston F and a speed governor having the rod and piston A D working in the cylinder C, whereby a given volume of air may be maintained regardless of the steam pressure and the air resistance, as described.

## CONTENTS.

THE ENGINEER, June 2nd, 1882.



COMPARATIVE RESILIENCE OF VARIOUS KINDS OF TIMBER.—Ash being 1; fir, ·4; elm, ·54; pitch pine, ·57; teak, ·59; oak, ·63; spruce, ·64; yellow pine, ·64; cedar, ·66; chestnut, ·73; larch, ·84; beech, ·86. By resilience is meant the quality of springing back or toughness.

THE rate of taxation per head of population in the Australian colonies is as follows:—New South Wales, £1 19s. 4¼d.; Victoria, £2 0s. 2¾d.; South Australia, £2 0s. 0½d.; Queensland, £2 14s. 1d.; Tasmania, £2 13s. 7¼d.; Western Australia, £3 5s. 9¾d.; New Zealand, £3 4s. 9d. General average, £2 6s. 4¼d.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending May 27th, 1882:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 10,460; mercantile marine, building materials, and other collections, 3462. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. till 6 p.m., Museum, 2408; mercantile marine, building materials, and other collections, 499. Total, 16,829. Average of corresponding week in former years, 16,978. Total from the opening of the Museum 20,954 832.