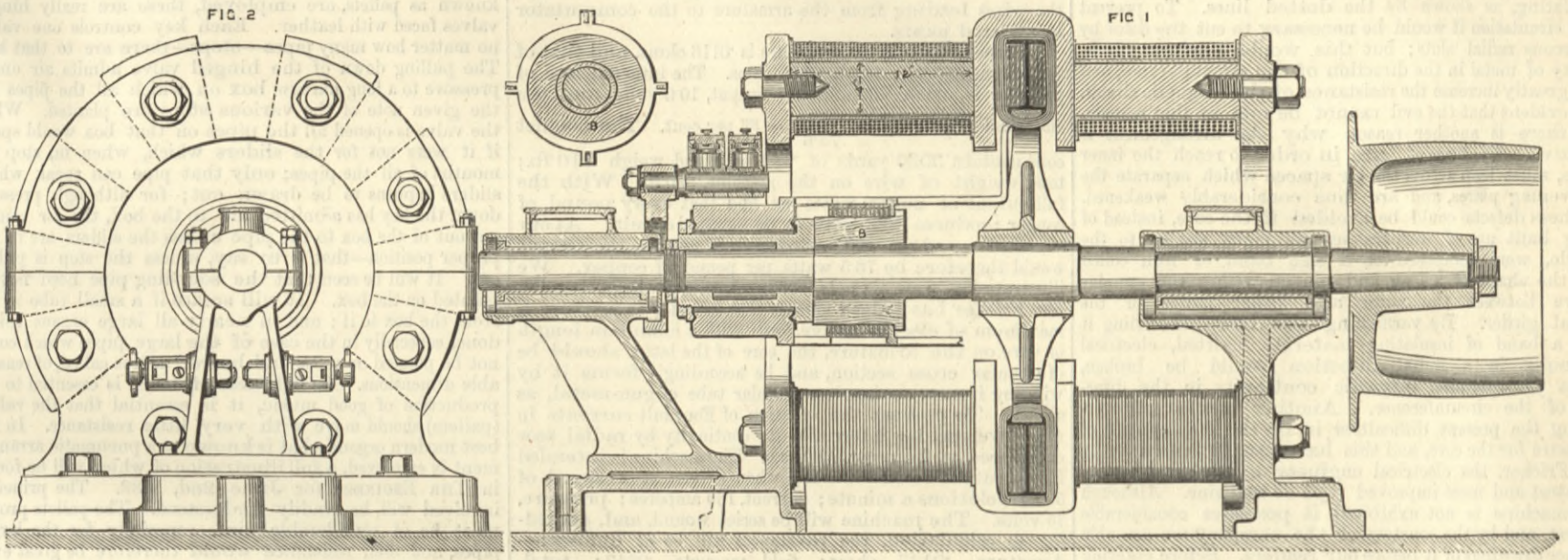
ELECTRICAL ENGINEERING AT THE INVENTIONS EXHIBITION.

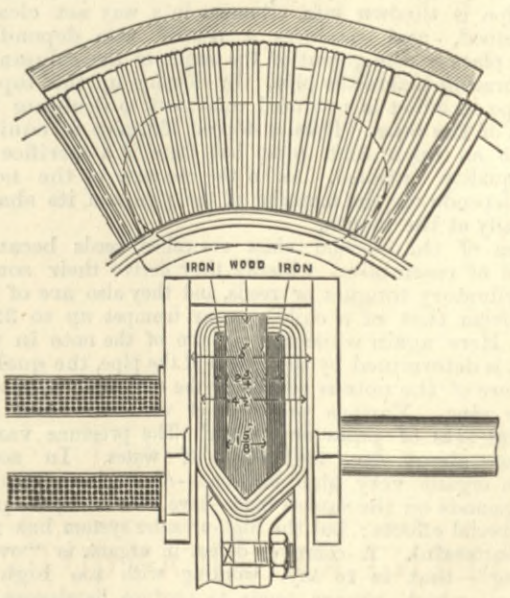
No. XI.

The Gülcher Electric Light and Power Company exhibits several large machines of the Gülcher type, or, to speak the language of the company's catalogue, of its safety system. This word system reminds one of those early days of electric lighting when companies could only be formed and business undertaken by those who had a complete system ready to hand. Nobody asked whether the dynamo taken by itself was a good machine, or whether the lamps were such that they would burn steadily with a given current and at a given difference of potential; all that was required was that machine, switches, leads, and lamps should belong to the same system, and that the whole should make a good show. Although it must be admitted that an electric light installation, like every other engineering work, can only be successful if every single part of it is adapted to its special duty, and in so far forms part of an organised system, yet too rigid an adherence to any special system may occasionally stand in the way of a natural development of electric lighting. Take, for instance, the original Brush system as first imported into this country. The dynamo was of excellent workmanshp, required hardly any repairs for years, and was eminently suitable for lighting a large number of arc lamps in series. The system was essentially one of high tension currents, and if the company had strictly adhered to it, it would have found it difficult to utilise to the best advantage two subsequent and very important inventions, viz., the storage battery and the incandescent lamp. It wisely determined to drop the high tension system when using incandescent lamps and to build up a special dynamo for the purpose. The Gülcher system is essentially one of low tension currents, the pressure being fixed at only 65 volts. No doubt, in the early days of electric lighting, when the danger of electric currents was but imperfectly understood and almost generally overrated, such a low pressure, on account of its supposed perfect safety, was a very attractive part of the Gülcher system. Now-a-days we know that to touch two wires between which exists a constant difference of potential of even 300 volts, may be unpleasant, but cannot be considered dangerous, whilst from a current flowing under a pressure of only 50 volts a dangerous shock is possible if the current be suddenly interrupted. The whole question of safety has shifted in the last few years, and nobody considers it in the slightest degree dangerous to maintain 100, or even 200 volts in the main circuit of an incandescent installation. In fact, the standard pressure for incandescent machines is now 110 volts, in order that with due allowance for the loss of pressure in the leads 100 volt lamps coupled parallel can be used. The Gülcher Company, however, still seems to adhere to its original "safety system." It builds its machines for 65 volts, and claims as a special advantage of this that it is able to burn arc lamps and incandescent lamps in parallel connection. Now, the difference of potential on the terminals of any arc lamp is generally from 40 to 50 volts. If more pressure is employed the arc becomes too long, and the light, instead of being white and steady, becomes flaring and of many colours. To bring down the pressure from 65 to 50 volts a resistance must be inserted into every branch, and this entails a heavy loss of power, to say nothing of the additional fire risk incurred by the heating of the resistance coil. The latter can, of course, be avoided by proper precautions being taken for carrying away the heat by ventilation of the coil, but the fact remains that we generate the current at 65 volts and utilise it at 50 volts, or even at a lower pressure. Here we have a clear loss of at least 23 per cent. of the output of the machine. If the potential were fixed at 110 volts, two arc lamps could be placed in series, and a sacrifice of 10 volts in an additional resistance would be quite sufficient to enable the lamps to feed properly. We do not know whether the Gülcher lamps can work in series, but there are several good differential lamps in the market which can be so arranged, and will burn with a perfectly steady light in parallel with incandescent lamps off the same circuit. To perform this feat no special system is required; a good self-regulating dynamo driven at a constant speed, properly arranged leads, and good arc lamps, is all that is needed. In making the foregoing remarks we do not wish in any way to criticise the Gülcher dynamo or the Gülcher lamp *per se*, but we wish in fairness to the electric lighting industry generally to point out that other systems, or, for the matter of that, installations put up without regard to any special system, may be just as safe as that advocated by the Gülcher Company. As a matter of fact safety does not depend on the system, but on the men who design and put up the installation.



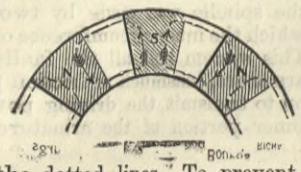
GULCHER DYNAMOS.

The Gülcher dynamo belongs to the class of disc machines, and in common with other dynamos of that class it has of late years been improved by the multiplication of its field magnets. It is worthy of note that recent improvements in cylinder machines have mostly been in the direction of heavier armature cores and stronger fields, but not multiplication of poles; whilst in disc machines the greatest improvement has been effected by increasing the number of field magnets and poles. Thus the original Gülcher machine had four poles, and gave a current of 220 ampères at 65 volts. The machines now exhibited have eight poles, and give each a current of 400 ampères at the same pressure, their over-all dimensions being nearly the same. It must not be thought, however, that the multiplication of poles alone is the cause of nearly doubling the output; constructive details have also been greatly improved. As will be seen from the annexed sketches, which show parts of the original machine in section, the armature core consisted to a great extent of wood, there being only a comparatively small amount of iron in it in the shape of flat discs or washers fastened to each side of the central wooden ring. The attachment to the spindle was made by two gun-metal discs, between which the inner circumference of the armature was wedged. This system had all the faults of the original Gramme armature, inasmuch as friction pure and simple was relied on to transmit the driving power into the core, and the inner portion of the armature could not be ventilated.



The cores of the field magnets were of oblong cross section, and required therefore a greater length of exciting wire than would have been the case had they been circular. There was no cross coupling between coils of the same potential, thus necessitating the employment of four brushes. The resistance of the armature was ·063 ohms, that of the magnets ·065 ohms; total, ·128 ohms. With the full output of 220 ampères, the internal loss of electro-motive force was therefore 28 volts, whilst the total electro-motive force developed was only 83 volts. The modern machines shown by the company are in every way an improvement upon the original type. We illustrate in Figs. 1 and 2 a longitudinal section and end elevation of their No. 6 dynamo. The core of the armature consists of a central web of malleable iron, resembling a double T girder bent into a circle, and of thin iron plates laid into the two annular grooves between the outer and inner flanges of the girder. The plates are insulated from each other by distance pieces, and air is admitted into the space between the plates by a series of holes drilled parallel to the spindle in those parts of the core which are not covered by the coils. Each coil consists of twenty turns arranged in four layers of five turns each, and as the coils are placed radially, there remain between successive coils wedge-shaped portions of the core which are exposed to the air. The core is mounted on a gun-metal wheel with flat arms radiating from a central hub which is keyed to the spindle, and thus the driving power is transmitted in a positive way to the core. The outer flange of the girder is provided with rectangular projections filling the space between neighbouring coils on the outer periphery, and holes are drilled into these projections in a radial direction, by

which the air entering laterally into the core may escape. These projections serve the double purpose of firmly holding the coils in place and of drawing in lines of force from the pole pieces in the well-known manner of the Pacinotti armature. The magnets are arranged to the right and left of the armature and are placed parallel to the spindle. Although the pole pieces surround the core on three sides, it is evident that the greatest number of lines of force enter the core in a direction at right angles to the surface of the iron plates or washers, and herein lies a weakness of the machine. The reason is obvious. We know that in solid bodies revolving before magnetic poles the tendency is to develope currents at right angles to the lines of force and at right angles to the direction of motion. In the present case the tendency will therefore be to induce currents in each plate in a radial direction, from the centre in those parts of the discs which at any time happen to be between one set of poles and towards the centre in those parts which are between the other set of poles. Let the shaded portions in the annexed sketch represent the polar surfaces, and the arrows the directions in which the electro-motive forces are set up, then it will be clear that in each plate there will be a series of internal currents circulating, as shown by the dotted lines. To prevent their circulation it would be necessary to cut the discs by numerous radial slots; but this would produce discontinuity of metal in the direction of the circumference, and thus greatly increase the resistance of the magnetic circuit. It is evident that the evil cannot be met by that remedy. But there is another reason why the arrangement is defective. The lines of force, in order to reach the inner plates, must leap across the air spaces which separate the intervening plates, and are thus considerably weakened. All these defects could be avoided if the core, instead of being built up of washers set at right angles to the spindle, were composed of a flat band of iron coiled into the shape of a ring and placed within the annular groove between the outer and inner flange of the central girder. By varnishing the band, or coiling it with a band of insulating material inserted, electrical continuity in a radial direction would be broken, whilst yet retaining magnetic continuity in the direction of the circumference. Another method of overcoming the present difficulties is by the employment of iron wire for the core, and this has actually been done by Mr. Fricker, the electrical engineer to the company, in the latest and most improved type of machine. Although this machine is not exhibited it possesses considerable interest, and by the courtesy of the company we are able to place drawings of it before our readers. Before entering on its description we must yet say a few words about the machines actually exhibited. By increasing the number of poles from four to eight the output of the machine has been nearly doubled. It is easy to understand that by increasing the number of points on the commutator where we can draw current off—in other words, by subdividing the armature into a greater number of sections which are grouped parallel—we shall obtain a corresponding increase of current; but it is not so easy to see at the first glance whether or not this gain of current will be accompanied by a proportional loss of pressure. If we were to judge simply by analogy with voltaic cells we should expect to find such a loss, for everybody knows that by grouping the cells of a battery parallel we gain current but lose electro-motive force. Analogies, however, are often misleading, and to be safe from error we must decide the present case on its own merits, quite apart from any semblance it may have with something else. The average electro-motive force developed in a coil whilst passing from one neutral position of the field to the other is inversely proportional to the time occupied in making the transit, and directly proportional to the total number of lines of force which pass through the armature core on their way from one pole of the field magnets to the next pole of opposite sign. If n coils are contained in that section of the armature which corresponds to the angular distance between the two neutral points in the field, the electro-motive force developed between the brushes will be n times that of a single coil. If we now double the number of poles there will only be $\frac{n}{2}$ coils between the two brushes, and the total electro-motive force will be $\frac{n}{2}$ times that of a single coil. But the time occupied by each coil to move from one neutral space to the other is also only one-half of its previous amount, and if the number of lines passing from pole to pole has not been altered, the electro-motive force of each single coil will be doubled. The total electro-motive force taken from brush to brush has therefore not been altered, although the current has been doubled. Now, it might be asked, why not double the number of poles once more and again get a proportional increase of current? The answer is that we would soon encounter a limit to this process of multiplication of poles in the difficulty of providing polar surfaces large enough for the passage of the full number of lines. The more poles we place around an armature of given diameter the smaller must each pole be, and the nearer will neighbouring poles of opposite sign come to each other. This has the double disadvantage of increasing the resistance of the magnetic circuit and of causing considerable leakage of lines, which, passing direct between the poles without touching the armature core, are, of course, lost for the production of electro-motive force. To counteract these influences it is necessary to unduly increase the exciting power on the magnets. We are inclined to think that the limit has been closely approached, and perhaps already overstepped, in the eight pole Gülcher machine, for if we neglect leakage of lines between the poles we find, on theoretical grounds, that an exciting power of 8000 ampèreturns on each horseshoe—or 4000 ampèreturns on each of the sixteen magnets—would be amply sufficient to get the full number of lines into the armature; whilst, in



reality, the exciting power on each horseshoe is 19,000 ampèreturns when the machine is giving the full output of 400 ampères. There are fifty-six coils of ·160 wire on the armature, each containing twenty turns, or in all 1120 turns. The mean perimeter of each coil is ·527 yards, so that the total length of wire on the armature is 590 yards, its weight being 140 lb. At 400 revolutions a minute the external pressure is 65 volts, and since there are four distinct circuits, we find that $\frac{590}{4} = 147{\cdot}5$ yards of wire produce 65 volts, or 2·26 yards of armature conductor are required for every volt in the external circuit. The armature core contains 2 square inches of malleable iron and 6·25 square inches of wrought iron. The magnet cores are cylindrical bars, 4in. diameter and 12in. long. Each core is wound with six layers of ·160 wire, there being sixty-three turns in one layer, and all the sixteen magnets are coupled parallel. The machine is coupled up as a series dynamo, and with the full output the density of current is 2500 ampères per square inch of armature wire, and 1250 ampères per square inch of magnet wire. Since the employment of eight brushes would lead to serious practical difficulties, the system of cross-connections—described in our impression of July 24th, p. 62—is made use of. The connections are made by a series of copper discs, each provided with four lugs as shown at B in our illustration. The discs are insulated from each other, and are mounted on a wooden hub. The lugs are connected to the wires leading from the armature to the commutator by soldered joints.

The resistance of the armature is ·0116 ohms, and that of the magnets ·015; total, ·0266 ohms. The internal loss of pressure is, with 400 ampères output, 10·6 volts, and the electrical efficiency is $\frac{65}{75{\cdot}6} = 86$ per cent. The magnet coils contain 3030 yards of ·160 wire, and weigh 710 lb.; total weight of wire on the machine, 850 lb. With the full output of 26,000 watts we find that every pound of copper produces 30·6 watts in the external circuit. At our standard speed of 1000 revolutions a minute, the output would therefore be 76·5 watts per pound of copper. We illustrate the new six pole Gülcher machine in Figs. 3 and 4. Mr. Fricker has judged rightly that in order to produce a maximum of electro-motive force with a minimum length of wire on the armature, the core of the latter should be of circular cross section, and he accordingly forms it by winding iron wire into an annular tube of gun-metal, as shown. To prevent the creation of Foucault currents in this envelope, he interrupts its continuity by radial saw cuts placed at frequent intervals. The machine is intended for an output of 12·000 watts when driven at a speed of 500 revolutions a minute; current, 160 ampères; pressure, 75 volts. The machine will be series wound, and, according to calculation, the resistances will be as follows:—Armature, ·0147 ohms; field magnets, ·0243; total, ·0390 ohms when at work. Loss of pressure, 6·2 volts; efficiency, 92·3 per cent.

THE NEW ORGAN IN WESTMINSTER ABBEY.

The modern organ possesses a structure so ingenious that it presents a great deal which cannot and does not fail to interest engineers. Its mechanical details, indeed, are marked throughout by a remarkable perception of the proper means required to attain a given end; and the splendid instrument which we illustrate this week is replete with mechanical refinements, which render it in every respect worthy of study.

In our impression for June 2nd, 1882, we illustrated the Crystal Palace organ as rebuilt by Messrs. Gray and Davison, and we then described in considerable detail the principles of an organ as a whole. It will be unnecessary, in describing the Westminster organ, to go over the ground again, but it will be well to give a few words of explanation, which will render what follows intelligible.

The music of an organ is produced, as is well known, by blowing air into pipes. These pipes may be divided into two distinct classes, technically known as flue pipes and reed pipes. The first are neither more nor less than whistles; they vary in size from about ⅜in. long and ⅜in. in diameter to over 32ft. long and 2ft. in diameter, or even in some cases to 3ft. square. In all cases they have a slot, in a flat plate or languid, as it is sometimes called, through which the air rushes and is split into two columns by a sharp edge or tongue. The column which ascends inside the pipe is thrown into vibration in a way not clearly understood, and produces a musical note depending for its place in the gamut on the length of the column of air vibrating inside the pipe. By stopping up the top of the pipe an effect is produced equivalent to doubling the length of the pipe. Thus, a stopped 16ft. pipe is equivalent to an open 32ft. pipe, but there is a sacrifice of tone quality entailed. As to the *character* of the note, that depends on the material of the pipe and its shape, especially at the mouth.

Pipes of the second class are called reeds because, instead of resembling whistles they derive their sound from vibratory tongues or reeds, and they also are of all sizes, from that of a child's penny trumpet up to 32ft. long. Here again while the position of the note in the gamut is determined by the length of the pipe, the quality or nature of the note is settled by the reed and the shape of the pipe. Various pressures of wind are used for different sets of pipes or "stops." The pressure varies between about 4in. and 14in. of water. In some foreign organs very high pressures—as much as two or three pounds on the square inch—have been tried, to produce special effects; but the high-pressure system has not been successful. A common defect in organs is "overblowing"—that is to say, working with too high a pressure, which always tends to produce harshness of voice.

Each pipe in an organ can produce but one note, and consequently for every note there must be a separate pipe, but besides this each key may control several stops, in which case there is an equal number of pipes. Thus, if we take an octave controlling five stops, we have thirteen tones and semi-tones, and $5 \times 13 = 65$ separate pipes. That is to say, we have five D's, five C's, and so on, and the D key is able to sound D on, let us say, a Hohl flute, a dulciana, keraulophone, a cor Anglaise, and a Suabe flute. By the use of sliders—thin plates of wood with holes in them—pushed in and out by the draw stops at the side of the organist, any one or all of these pipes may be shut off. If all the five stops we have named are pulled out at once, then when the key D is put down by the organist, all the D pipes of the stops we have named will speak. If they are all pushed in but one, say the Suabe flute, then that only will be heard. The organist has therefore, in a sense, a band under his control, and much of his talent is shown by the way in which he combines his stops to produce the best orchestral effect.

Furthermore, it must not be forgotten that every organ of any importance is composed of several distinct instruments, each controlled by its own separate keyboard. Thus, in the Westminster organ there are four keyboards and a set of pedals, or five organs in all, but by a very ingenious arrangement known as a coupler, the keyboard of any one organ can be made to control the keys of any or all the others. A full list of the couplers, no less than twelve in number, of the Westminster organ will be found further on.

In order to admit the air to the pipes, valves, technically known as pallets, are employed, these are really hinged valves faced with leather. Each key controls one valve, no matter how many pipes—stops—there are to that key. The pulling down of the hinged valve admits air under pressure to a long narrow box on which all the pipes for the given note of the various stops are planted. When the valve is opened all the pipes on that box would speak if it were not for the sliders which, when in, stop the mouths of all the pipes; only that pipe can speak whose sliders happens to be drawn out; for although pressing down the key has admitted air to the box, the air cannot get out of the box to the pipe unless the sliders are in the proper position—that is to say, unless the stop is pulled out. It will be seen that the sounding pipe need not be planted on the box. It will suffice if a small tube is led from the box to it; and in nearly all large organs this is done, especially in the case of the large pipes which could not be planted on a "sound-board," as it is called, of reasonable dimensions. As lightness of touch is essential to the production of good music, it is essential that the valves (pallets) should move with very little resistance. In the best modern organs what is known as a pneumatic arrangement is employed, a full illustration of which will be found in The Engineer for June 2nd, 1882. The principle involved will be readily understood. The pallets proper must be of considerable size, especially for the larger pipes, and their resistance would therefore be great even when balanced, because balancing cannot be carried too far, or the pallets would not shut with sufficient promptitude. To get over the difficulty and take the strain off the organist's fingers, the keys control small pallets carefully balanced, and these admit wind to valve boxes, which wind pulls down the pallet controlling the speaking pipes. The arrangement closely resembles that in use in some steam pumps, where a very small valve admits steam to work a large valve.

It will be understood that it is necessary to place the pipes of an organ in various positions, and a glance at our double-page cut will show that the pipes are scattered over a great area; some are on the ground floor or floor level of the Abbey; others stand high up near the roof; others, again, are behind the organist, who sits in the centre of the screen facing the north. In old practice there was only one way of connecting the keys with the pipes, namely, by light rods of wood and wire called trackers, which were always heavy to move and liable to get out of order. In the Westminster organ air tubes are used instead of trackers, and the motion of the key under the organist's finger is responded to by the instantaneous opening of pallets all over the organ under the impulse of the air pressure transmitted through these tracker pipes, as we may call them. The sliders are worked in the same way. Nothing can be more elegant in its application or satisfactory in practice than this beautiful system of transmitting power to a distance. What we have now said will, we believe, render all that follows quite intelligible. Those who wish to go further into the subject we must refer to our impression for June 2nd, 1882.

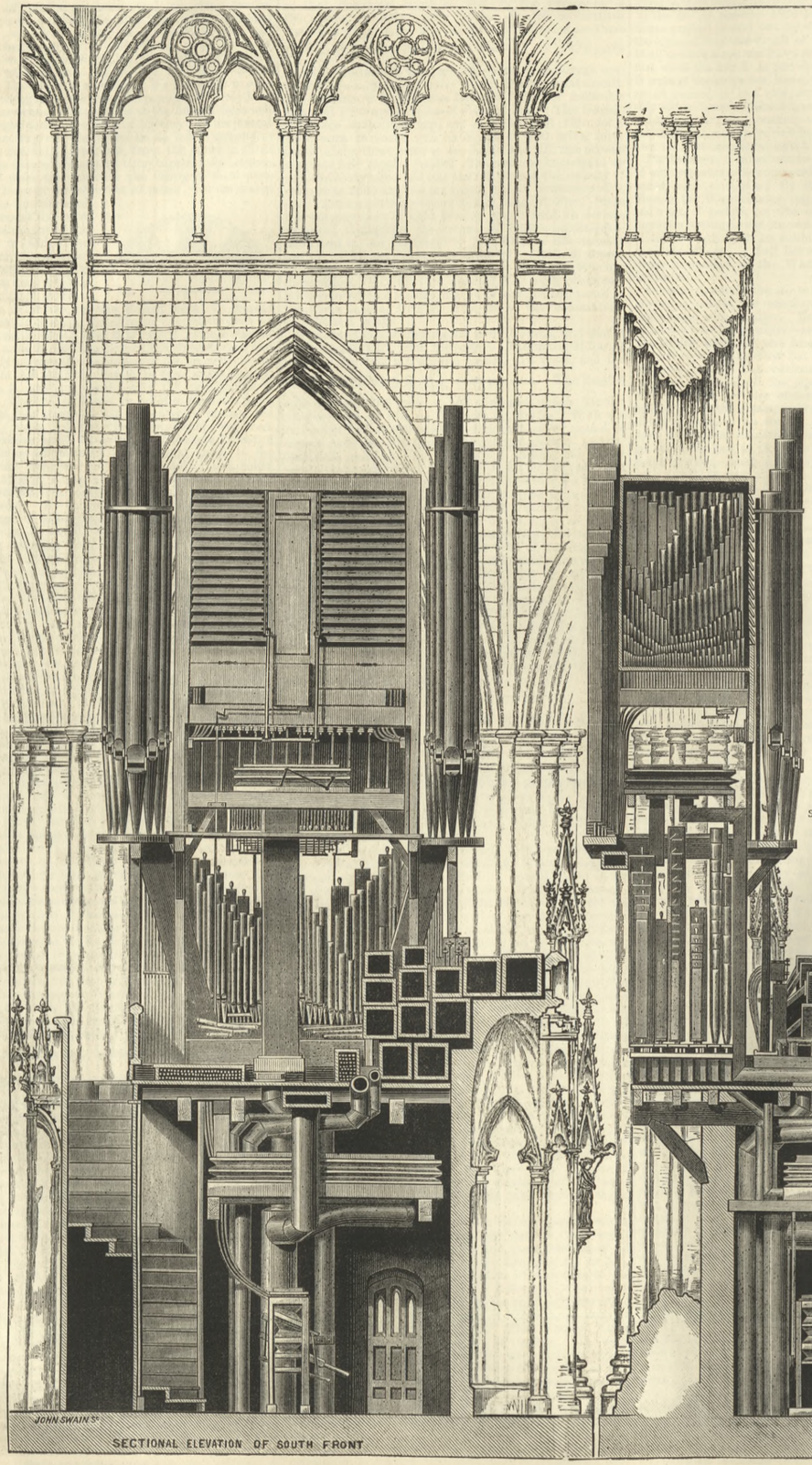
The Westminster Abbey organ is one of the most representative among the great organs which have lately been built in this country. Few church organs are of larger size regarding the number and variety of stops, and none exhibit a more complete system of scientific action and appliances of the most recent class of invention. The organ which has now given place to the new instrument was built in 1730 by Schreider and Jordon, who were well-known and excellent builders of their time. The scope of English organ-building in the eighteenth century was, however, extremely limited, and in no way to be compared with the art as practised on the Continent, especially in Germany, where fine, large organs were built before the time of Bach. The Abbey instrument consisted of three manuals, of which the great and choir extended to G G, and the "echo" or swell to fiddle G only; while no pedal organ whatever was thought necessary, although this department was duly recognised a century before among our German and other neighbours. Avery added some pedal pipes—probably an octave only—at about the end of last century, and a few other alterations seem to have been made at that time.

In 1828 Messrs. Elliott and Hill supplied a new swell organ to tenor C, and extended the pedal pipes to G G G, 24ft. This was not the first occasion when this old firm had charge of the Abbey organ, having obtained the care of it at the beginning of the century, since which time it has received treatment from their hands only. In 1848 Messrs. Hill added an additional octave to the swell, thus extending its compass to C C, with extra stops of various kinds. The great organ was increased in size and enlarged to

THE NEW ORGAN, WESTMINSTER ABBEY.

MESSRS. W. HILL AND SON, YORK ROAD, LONDON, N.W., BUILDERS.

(For description see page 138.)



JOHN SWAIN Sc.

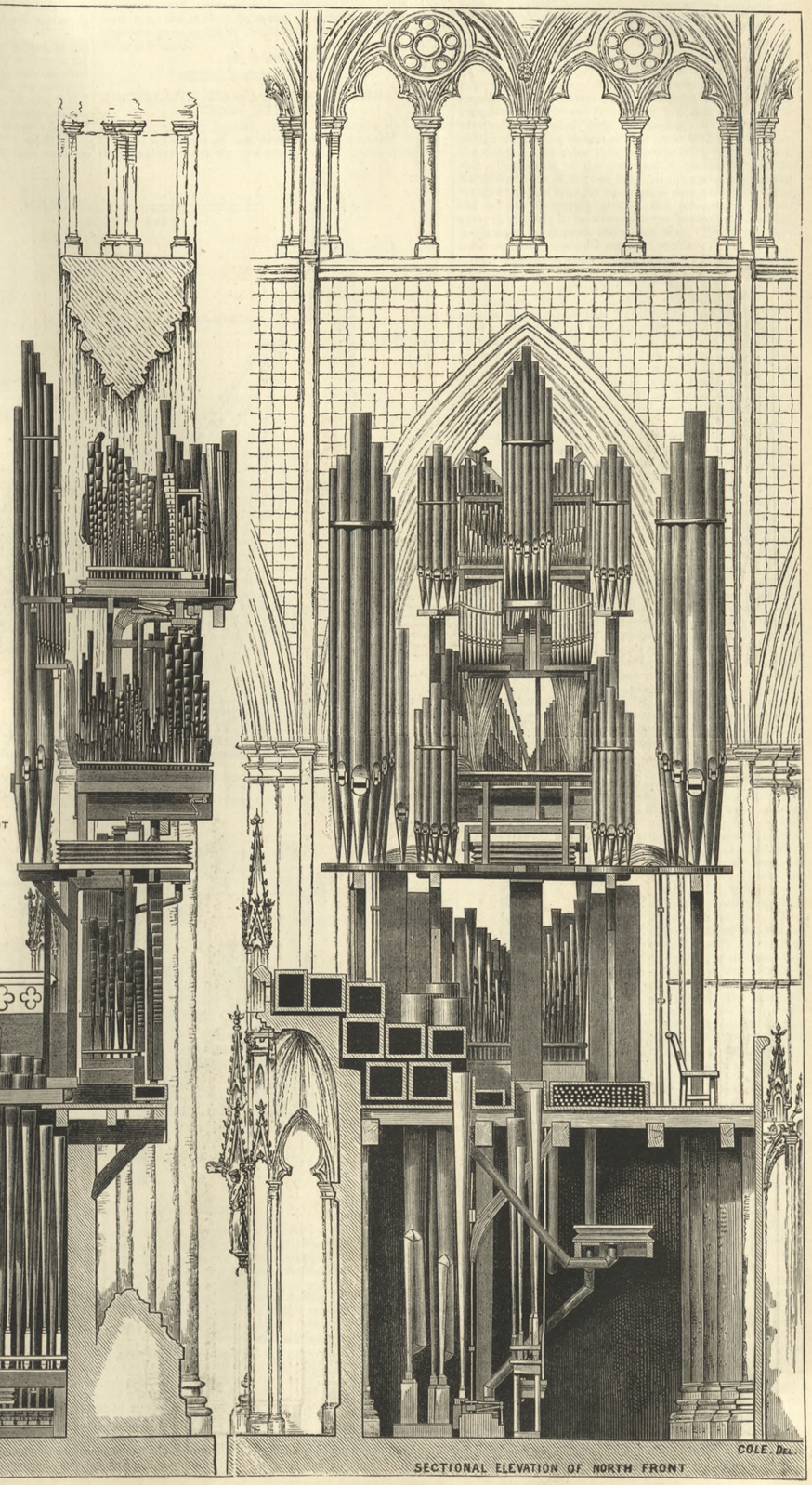
SECTIONAL ELEVATION OF SOUTH FRONT

SCALE 0 1 2 3 4 5 6 7 8 9 10 FEET

TRANSVERSE SECTION

SOUTH FRONT

NORTH FRONT



COLE. Del.

SECTIONAL ELEVATION OF NORTH FRONT

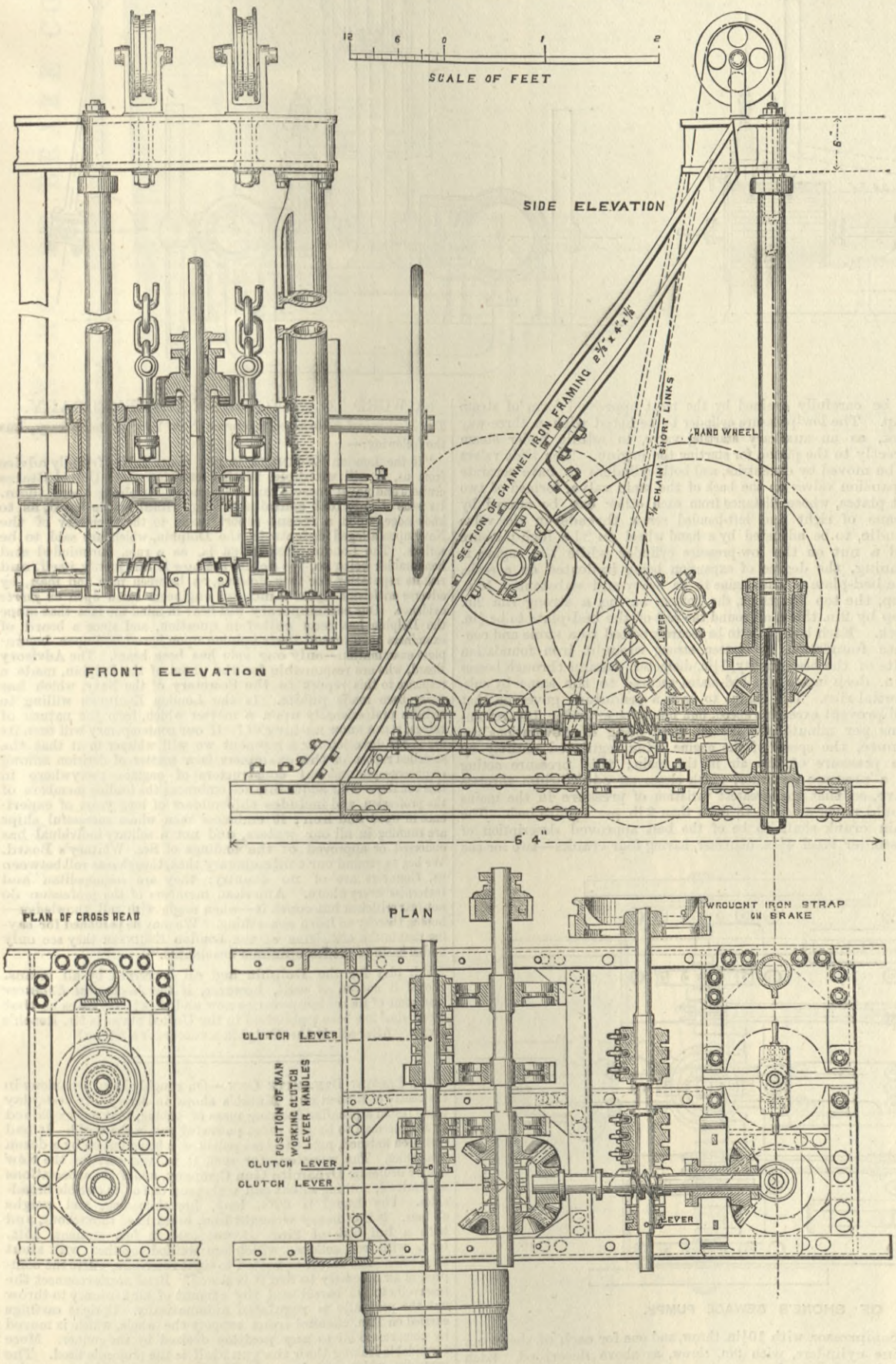
the C C C compass, and the pedal keys made to act upon the great clavier, and the pedal pipes carried down to C C C C, 32ft. This same firm in 1868 added a fourth manual, or solo organ, with a tuba, vox humana, and other solo stops, though great difficulty was experienced in finding room for these additions on the screen, already much encumbered by the 32ft. pedal pipes, which were laid horizontally for want of space on the north and south side.

Although these last alterations greatly added to the efficiency of the organ, yet there were many defects in the instrument as judged from a modern standpoint, the chief being the absence of a separate pedal organ, the cramped-up arrangement of the sound boards, and the C C C compass of the manuals. Mr. Turle, the late organist, was so accustomed to his instrument that he thought little of these imperfections, and it was only on the appointment of Dr. Bridge that attention was turned to the necessity of a complete alteration in the Abbey organ. For some time, however, the scheme was abandoned, and it was not till 1883 that Messrs. W. Hill and Son's plans for the rebuilding were finally accepted by the Chapter. It was then resolved entirely to reconstruct the organ, retaining only such stops and certain sound-boards of the old instrument as could be conveniently used again, and in doing this the most conservative spirit was manifested. The old great organ was originally on the north side of the screen, under the arch; the swell on the south; the choir and solo in the centre of the screen; and the pedal lying horizontally. It was determined greatly to increase the height of both the north and south organs; the great, solo, and portion of the pedal to occupy the former position; the swell and other portion of the pedal the latter; while it was found best to place the choir organ in the centre of the screen—towards the west—allowing the console to occupy a middle place, which will enable the player to see both the Decani and Cantoris sides of his choir in the stalls below. The space within the walls of the screen on the north side was also appropriated for the reception of the great 32ft. pedal reed, which requires considerable space. For some time the question of blowing and blowing power remained undecided, but eventually it was determined to construct a special vault in the cloister green, which could contain the blowing feeders, and also a gas engine to drive the same; and arrangements were made for taking the wind into the Abbey by means of underground pipes of large size passing from the vault to the reservoirs within the organ itself.

(To be continued.)

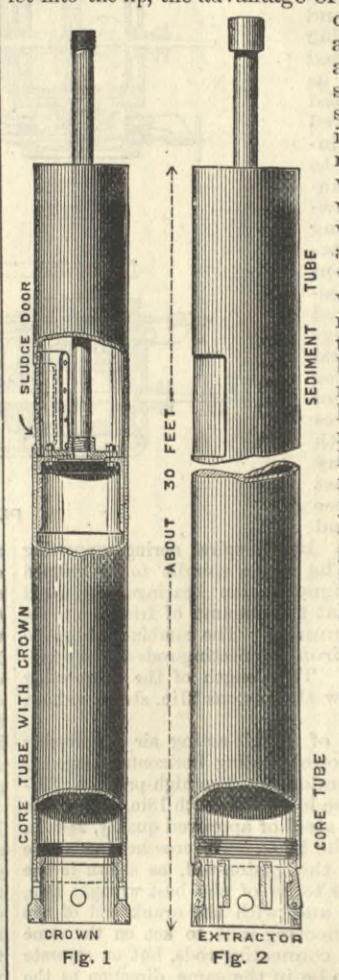
MISCELLANEOUS MACHINERY AT THE INVENTIONS EXHIBITION.

In the mining section, Messrs. T. Docwra and Son, London, show one of the latest types of diamond boring machines for making artesian wells and prospecting for minerals, the invention of Mr. J. K. Gulland, Westminster, and which is under the superintendence of Messrs. Price and Belsham, Queen Victoria-street, E.C. The use of black diamonds for boring purposes was commenced in this country about twelve or thirteen years ago, at which time the carbons could be obtained at about 4d. per carat, whereas now the price is from 20s. to 25s., according to the quality. Since then many hundreds of bore-holes have been put down in Great Britain, while a great number of machines have been sent abroad. No doubt the special reason why the diamond drill has met with such a large degree of success is the excellent evidence it gives of the strata bored through; the solid cores obtained by it enabling geologists and mining engineers to form much more correct ideas of the chances they have of realising the object of their search than was possible with the pulverised material brought to the surface with the old-fashioned boring tackle. The ordinary core tube is about 30ft. long, having a crown in which the diamonds are set, screwed on the end. The weight of the bore rods when revolving forces this crown into the strata, leaving a solid core standing up in the interior of the tube, this core, when the tube is withdrawn, catching on projecting claws and being brought up to the surface. The tubeis then emptied, lowered again, and refilled by the same process, so that as the boring advances a perfect record is kept of the strata penetrated. To avoid the possibility of a core dropping out, and in order to obtain a higher percentage of all cores, Mr. M. Belsham designed and patented a special core tube in 1874, which has been successfully used in many instances. It consists of an inner stationary tube pivotted to the socket of the outer or boring tube, an annular space being left between the two for the passage of water. After the crown cuts the core the inner tube forms a shield and receptacle for this core, which is effectually prevented from dropping out by means of sliding wedges, the weight of the core tending to contract the wedges. The inner tube is suspended from the first, and adjusts itself to the core as it passes up. At the Exhibition cores as large as 21in. in diameter may be seen which have been brought up from a depth of 800ft. below the surface. In testing ground for minerals it is, however, unnecessary to make such large borings, 4in. and 5in. in diameter being about the usual size. The larger bore holes are chiefly made for artesian wells.



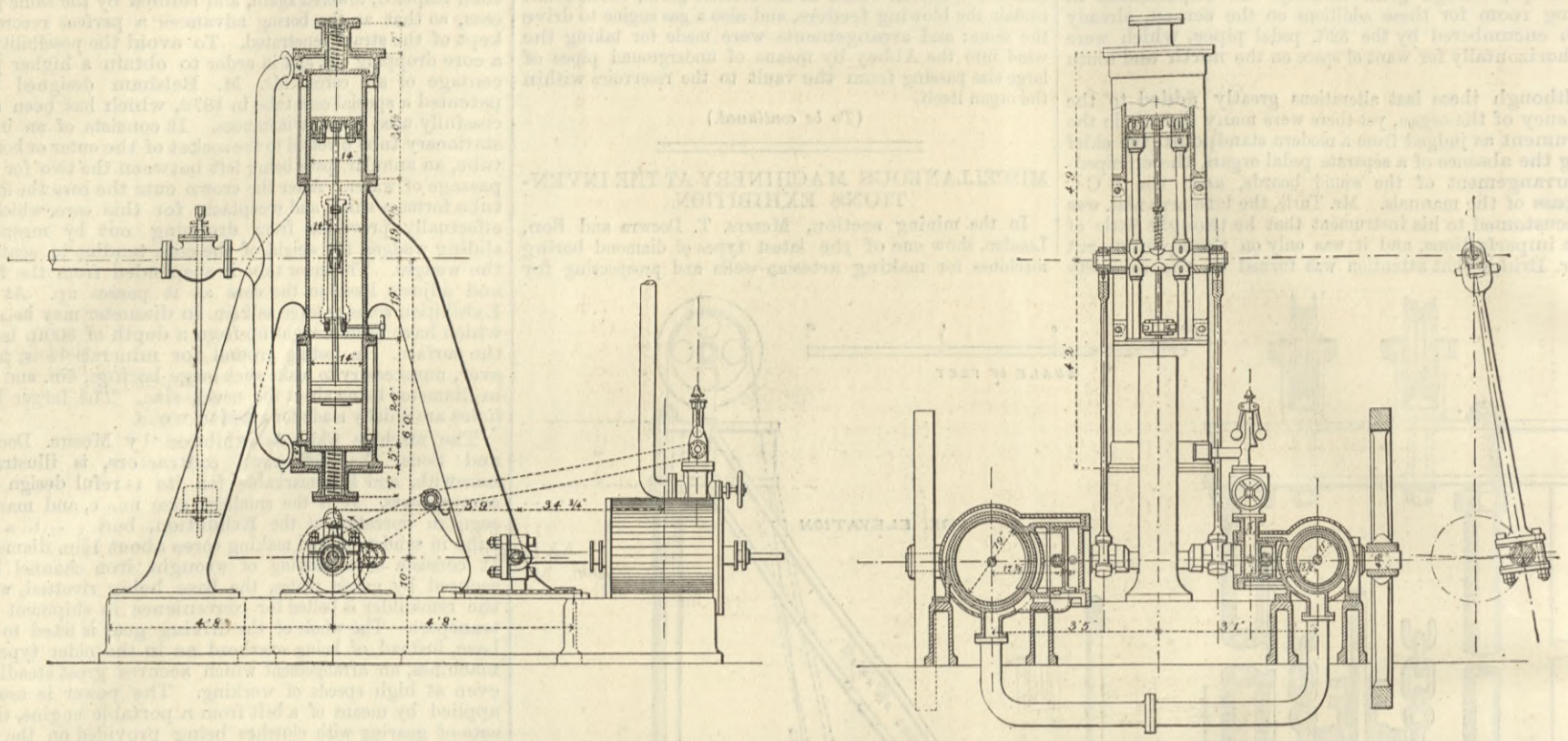
GULLAND'S PATENT DIAMOND BORING MACHINE.

The machine which is exhibited by Messrs. Docwra and Sons, the well-known contractors, is illustrated herewith, and is remarkable for its careful design and compactness. It is the smallest size made, and may be seen in operation at the Exhibition, boring with a 3in. tube in sandstone, and making cores about 1⅞in. diameter. It consists of a framing of wrought iron channel bars secured by gusset plates, the base being rivetted, while the remainder is bolted for convenience in shipment and transport. The whole of the driving gear is fixed to the base, instead of being overhead as in the older types of machines, an arrangement which secures great steadiness even at high speeds of working. The power is usually applied by means of a belt from a portable engine, three sets of gearing with clutches being provided on the first motion shaft, so as to vary the speed according to the nature of the work. These three powers may be used either in boring or in drawing the rods, and are ready the instant they are required, so obviating the necessity of changing wheels. There is also a special arrangement of worm gearing, by means of which a heavy strain can be exerted direct on the bore-rods in order to break off the core, or to be used if required in cases of emergency. This worm gearing may be actuated either by power or by hand. The boring-rods are counterbalanced by means of a wire rope wound round a drum, which is caused to revolve by gearing. One of the principal and most important features in the machine is the moving crosshead, a section through which is shown. This crosshead is made to swing round on the wrought iron vertical shaft by which the power is transmitted to the boring tools, thus enabling the rods to be uncoupled with great ease, and doing away with the necessity of moving the machine, or having a raised platform at a height of from 8ft. to 10ft. from the ground. Greater lengths can also be drawn, which is of considerable advantage when this operation has to be performed several times during the day. For lifting the rods a chain is provided, actuated by a suitable drum, and leading over a sheave at the top of the shear legs. The usual method of setting the carbons in boring crowns is by shaping holes in the lip to suit each piece, and then securing them by caulking the steel all round. When large sized crowns are being used in a moderately hard stratum, the carbons are inserted in tapered steel plugs, which are afterwards let into the lip, the advantage of this plan being that they can readily be removed and re-set in a crown of another size, thereby considerably reducing the stock of carbons. The importance of this will be more readily appreciated when it is stated that the value of a large crown is very frequently as much as £500. The speed of working the boring-rods varies according to the nature of the stratum and the size of hole, but may be taken at about 200 revolutions per minute for holes from 3in. to 6in. diameter, down to fifty revolutions for large sizes. The rate of boring is also subject to great variation, but an average working progress may be reckoned at about 20ft. per day for the larger sizes. During the whole time of boring, water is forced down the tubes by an independent pump, in order to cool the crown and wash away the cuttings. Fig. 1 is a view of boring tube with crown attached, the upper portion being formed into a sediment box for receiving the larger cuttings washed up by the water. These pass up round the outside of the tube, and fall over the upper edge into the box, from whence they are cleared out from time to time. Fig. 2 is the same tube as the foregoing with the crown replaced by an extractor, which is used in breaking off and drawing cores. An addition to the arrangement as illustrated is sometimes made by placing a winding drum on a frame between the portable



SHONE'S HYDRO-PNEUMATIC SEWAGE PUMPS.

HENLEY-ON-THAMES SEWAGE WORKS.



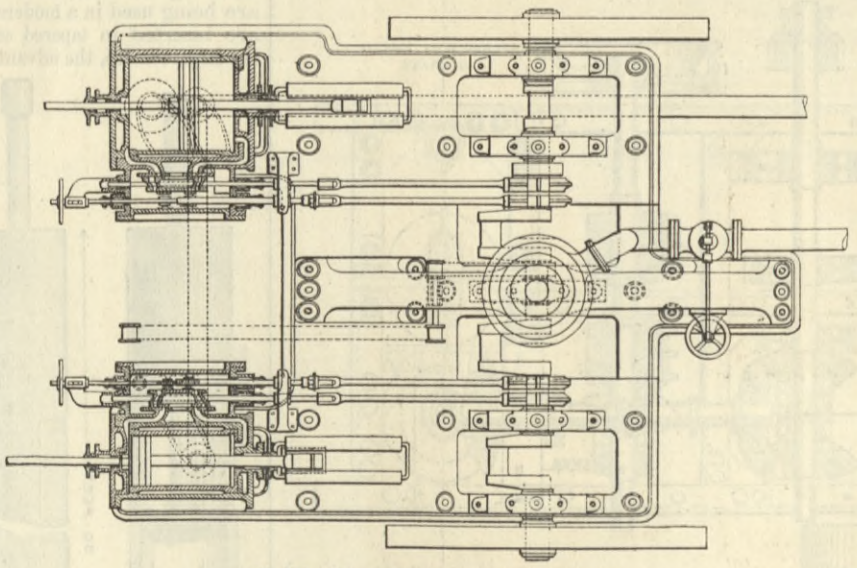
engine and machine, this being used in connection with a wire rope for quickly clearing out sand or loose pieces of rock from a deep bore-hole. A special tool is provided for this purpose, and as it can be lowered to a depth of even 1000ft. in a few seconds, and withdrawn almost as rapidly, it is very much more expeditious than uncoupling and coupling up screwed rods.

The samples of cores to be seen at Messrs. Docwra and Sons stand, are all from actual borings made in London and neighbourhood. One piece taken from a depth of about 830ft. at Kettering-road, Northampton, is a good example of what the diamond drill can do. We understand that a large number of Gulland's patent machines have been constructed, and have been used most successfully both in this country and abroad. As already stated, the apparatus has evidently been very carefully designed, and is both neat-looking and substantial in construction. The workmanship and finish seem all that could be desired.

HENLEY-ON-THAMES SEWERAGE WORKS ON THE SHONE HYDRO-PNEUMATIC SYSTEM.

We publish engravings of some of the machinery which is to be used in carrying out this system at Henley-on-Thames. The description which follows is from the specification:—

The air compressors to be in duplicate of the type known as Sturgeon's trunk air compressors, with Shone and Ault's improvements thereto. The air compressors to be vertical on strong cast iron box standards, and to consist of two single-acting cylinders 14in. diameter, bolted securely to the standards, as shown in the drawing, and fitted with water jackets screwed round the cylinders. The cylinder ends to be movable, and to act as outlet valves for compressed air, as shown on drawings. The two single-acting pistons to be securely bolted together by wrought iron piston-rods connected to a centre cross-head. The pistons to be fitted with cast iron piston rings pressed outwards with spiral springs. The inlet valves for free air to be in the centre of the pistons, and the two valves to be connected together with a valve spindle in such a way that one of the valves must always be open when the other is shut. The valve spindle and inlet valves to be balanced by a spiral spring supporting the weight of the same. The valve spindle to be gripped by a friction clutch with lignum vitæ bearings, and fitted with a screw in such a way that the amount of friction can be adjusted while the engine is running. The combined pistons to be moved by two wrought iron connecting-rods and by two cranks, each of 10½in. throw. The length of the compressing cylinders to be such as to allow the pistons 21in. stroke without any clearance whatever.



PLAN OF SHONE'S SEWAGE PUMPS.

Steam engines.—Each pair of single-acting air compressing cylinders to be fitted with a double-acting horizontal compound steam engine with injection condenser. The high-pressure cylinder to be 11in. diameter, and the low 19in., both 18in. stroke. The piston-rods to be of Bessemer steel of approved quality, 2⅜in. in front and $1\frac{9}{16}$in. diameter at the back. The crosshead and guide to be made in one piece with the piston-rod, as shown in the drawing. The connecting-rods to be of the best wrought iron, forked in the crosshead end, and with the crank end of the usual marine type. The connecting-rods to act on the same shaft as the air compressing connecting-rods, but on separate cranks; one of these cranks to be in the same direction as the air compressing cranks; the other of these cranks to be at right angles to the other three. The pistons to be of the same description as the air compressing pistons. Both cylinders to have their sides and ends carefully steam jacketted; the steam jackets to be supplied with steam direct from the boilers, and to be carefully drained by the most approved form of steam trap. The low-pressure cylinder to be fitted with a three-way cock, as an auxiliary starting valve, to admit boiler steam directly to the piston for starting the engine. The slide valves to be moved by excentrics, and both cylinders to have separate expansion valves on the back of the main valve, formed of two flat plates, whose distance from each other can be altered by means of right and left-handed screw threads in the valve spindle, to be adjusted by a hand wheel on the high-pressure and a nut on the low-pressure cylinder while the engine is running, the degree of expansion being indicated on a scale. The bed-plate of the engine to be heavy and substantial, 15in. deep, the top 2in. thick, the bottom having a strong rim 2in. deep by 2in. thick, all round the rest of the bed-plate to be ⅝in. thick. Each bed-plate to be securely bolted to a stone and concrete foundation by sixteen strong wrought iron foundation bolts of the best quality, 1¼in. diameter, passing through bosses 15in. deep inside the bed-plates, secured to the same by substantial ribs. The engine to have a pendulum governor, that will prevent excessive speed, but not to act under 100 revolutions per minute, the normal speed being 45 revolutions per minute, the speed of the engine being regulated entirely by the pressure of the air in the main; this pressure acting on a pressure governor, which closes an equilibrium throttle valve, so that the greatest variation of pressure in the mains should never amount to more than 2 lb. per square inch. The main crank shaft to be of the best approved description of Bessemer steel 4½in. diameter, having four cranks—two for the air compressor, with 10½in. throw, and one for each of the steam engine cylinders, with 9in. throw, as above described. Each set of engines and compressor to be fitted with two fly-wheels, 6ft. diameter, and weighing about 15 cwt. each. The condenser to be fitted with an air pump driven from the main shaft by a 12in. pulley and belt. The air pump cylinder to be 10in. diameter, single-acting, 6in. stroke. All circular joints in the engines and compressors to be carefully tooled, filed, and ground together with emery, so as to fit steam-tight without any packing whatever. All bolts, screws, and studs best Swedish iron. All parts of the engines and compressors to be fitted with the greatest care, and to be of the best materials.

Steam boilers.—For each set of engines and compressors one Lancashire boiler has to be provided, 22ft. long over all. Boiler shell, 6ft. diameter, with two internal 27in. diameter flues. The grate to be 4ft. 4in. long; each internal flue to be fitted up with ten Galloway tubes. The boiler to have a steam dome 33in. diameter, 43in. high, two safety valves, and all the usual fittings. The front end plate of the boiler to be set back 9in. in the shell, and the space filled in with silicate cotton or other non-conducting material. Boiler to be of best wrought iron plates, and Lowmoor fire-box.

Tramway Engines.—A competitive and extended trial of steam and air tramway engines is proceeding in Antwerp; the steam engines are not fitted with condensers.

A WORD TO A FOREIGN CONTEMPORARY.

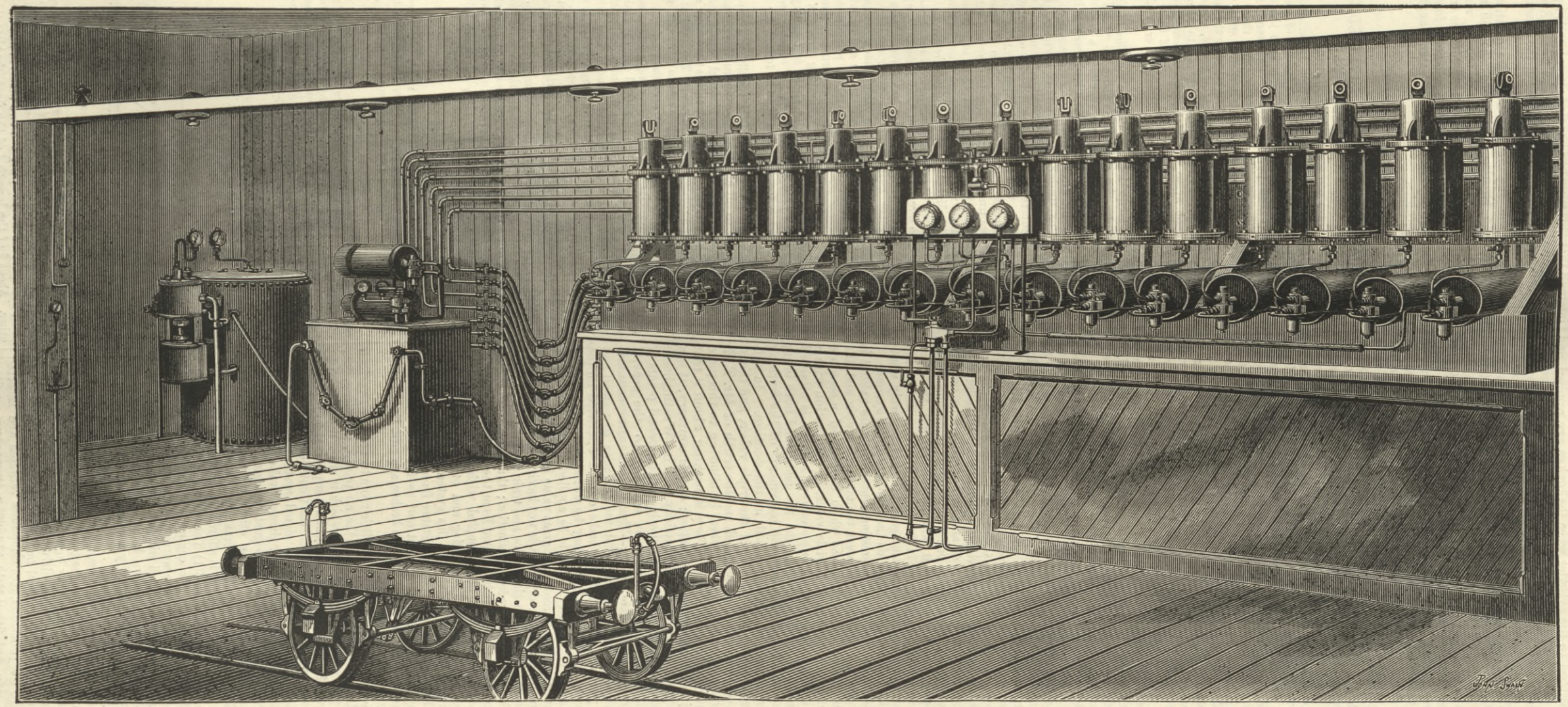
The *Mechanical Engineer*, a clever New York contemporary, has the following:—

"If the London Engineer is not above taking friendly advice from us, it will withhold further criticism upon United States cruisers and naval vessels until it knows something about them. Its issue of July 10th contains a long critical article based, as to knowledge, upon a recent report made to the Secretary of the Navy upon alleged defects in the Dolphin, which are said to be serious. The London Engineer is, as a rule, fair-minded and honourable; being so, we do not see how it can justify itself, and risk its reputation for fair dealing, as between man and man, by adverse criticisms upon American engineers based upon *ex parte* evidence. Our contemporary will bear in mind the fact that since the Dolphin has been called in question, and since a board of examiners have passed their opinion upon her—based upon incomplete examination—only one side has been heard. The Advisory Board, who are responsible for the plans of the Dolphin, made a response to this report to the Secretary of the Navy, which has never been made public. Is the London Engineer willing to criticise professionally upon a matter which, from the nature of things, it can know nothing of? If our contemporary will turn its ear in our direction for a moment we will whisper in it that the so-called report of the examiners is a matter of derision among engineers—professional constructors of engines—everywhere in this country. Our acquaintance embraces the leading members of the profession, and includes shipbuilders of long years of experience in wood and iron; it embraces men whose successful ships are running in all our waters, and not a solitary individual has endorsed or approved of the findings of Sec. Whitney's Board. We beg to remind our contemporary that, though seas roll between us, engineers are of no country; they are cosmopolitan and fraternise everywhere. American members of the profession do not fear criticism but court it—when made with full knowledge—hoping thereby to learn something. We may be pardoned for saying that in the criticisms of the London Engineer they see only undue haste to proffer opinions unsolicited."

Fair play for the Dolphin and all concerned by all means. Would it not be as well, however, if the *Mechanical Engineer* read some of its contemporaries now and then? It strikes us that a good deal has been published in the United States in Mr. Roach's favour. After all, is the Dolphin a success or a failure?

The Largest Dynamite Gun.—On roughly-hewn trunnions in the centre of Ribbon and March's shops in Jersey City yesterday there rested a peculiar looking mass of tubing, that was explained by the foreman to be the most powerful gun in the world. It had just been finished, and the last polish was being put on by a dozen mechanics. The monster, for such it is, was cast for the New York Pneumatic Dynamite Gun Company, and if the expectations are realised, nothing afloat can withstand one of its terrible broadsides. The barrel is 60ft. long, breech-loading, and weighs 43 tons. It is of heavy wrought iron, brass lined throughout, and with a full bore of 8in. It was cast in four sections, 15ft. long, with iron collars, which are welded together with stout steel bolts. The barrel is bolted to eight reservoirs, where the compressed air necessary to fire it is stored. Brass nozzles connect the reservoirs to the barrel and the amount of air necessary to throw out the projectile is regulated automatically. Upright castings carried on 12in. channel irons support the whole, which is moved by compressed air to any position desired by the gunner. More formidable looking than the gun itself is the projectile fired. The cartridge, which is of brass, is 5ft. long, and fits the bore snugly. In an iron cone at the head of the projectile 180 lb. of dynamite are stored, covered with a slight cap of thin metal, which is easily broken off, exploding the projectile wherever it strikes. When the gun is charged the gunner takes his stand on a platform behind the barrel, and by means of a lever closes the breech. By simply turning a crank the desired elevation is obtained and fixed. The lowest of the levers opens the nozzles leading from the air chambers and instantly the shaft cartridge is thrown out. Sufficient air to fire six projectiles is stored in the cylinders. There is no recoil, and the position of the gun remains unchanged. As soon as the carriage is completed aud the gun mounted it will be taken to Fort Lafayette, where the tests will be made under the supervision of a commission of naval men appointed by the Government to report the result of the experiments. "Yes, sir," said the foreman, as he proudly surveyed the gun yesterday, "that is the biggest piece of ordnance ever built in the world. It puts in the shade anything ever made by Krupp, and then it was all made in this little shop. Work was begun in October, but the boring was so difficult that it required much longer time than we calculated. It has been tested and shows no signs of weakening under a pressure of 2500 lb. to the square inch. I feel sure that it will revolutionise modern warfare, and for coast defence I think it has no equal." The company expects to sell the gun to Secretary Whitney if it proves serviceable, and it hopes to get orders for more of the same kind.—*New York World.*

THE INVENTIONS EXHIBITION—THE STAND OF THE WESTINGHOUSE BRAKE COMPANY.



RAILWAY BRAKES AT THE INVENTIONS EXHIBITION.

THE WESTINGHOUSE BRAKE.

The fact that most people are travellers by rail nowadays will, no doubt, in a great measure account for the interest exhibited by the general public in a subject which, though technical and scientific, plays such an important part as continuous brakes in ministering to their safety. There has from the first, indeed, existed a curious fascination on this subject of railway brakes, and people who in other matters were content passively to accept whatever was provided for them in the way of railway appliances, have taken sides on the brake question as being a personal matter intimately concerning themselves, and upon which they felt entitled to say something.

In dealing with this department of the Inventions Exhibition, it is not our intention to go into this wide field of the brake question, or to make invidious comparisons between the various systems. Our own opinions, formed after an intimate knowledge of the requirements to be fulfilled, and a careful study of the various systems, are pretty well known, and we have no new faith to proclaim. So long, indeed, as human nature and our present modes of travel remain as they are, so long will certain means of meeting certain contingencies continue to be required, and we should be wanting in our duty did we fail to recognise this fact or refrain from urging the railway companies to adopt the appliance which, in their own interest, as well as that of their passengers, we consider to be the best. From the importance of the subject, and knowing the position the Westinghouse Brake Company have from the first taken up on the brake question, it is not a matter for surprise that the Exhibition Committee have seen fit to grant an amount of space proportionate to the merits of the apparatus exhibited, which is indeed of great interest, and to those who take the trouble to make more than a cursory inspection, is really very instructive. Anyone, although possessed of little or no practical knowledge, can appreciate the beauty of the results here so graphically illustrated. Knowing that almost any kind of brake can be made to work on a model for exhibition, or upon the apparatus for two or three vehicles, the Westinghouse Company always prefers to illustrate its apparatus as working on a train, and in the present instance we find in the space granted it of 30ft. by 10ft., the full-sized apparatus for a train of fifteen carriages, extending over 400ft. in length. These fittings complete, with the exception, of course, of brake rigging, are arranged in a row as represented in our illustration, and each set consisting of brake cylinder, auxiliary reservoir, and a so-called triple valve, is connected as in actual practice to its length of the continuous train pipe, which is coiled on the screen at the back, the connection between each vehicle or length of piping being made by the usual flexible hose couplings. Our illustration, we may say, is confined to the mechanical details, and does not represent the general appearance of what is a handsome stand. It is clear that such an arrangement as now described is the best way in which a continuous brake should be exhibited, otherwise the idea of continuity is destroyed. It is, in fact, the only means by which the essential points which ought to be possessed by a brake can be detected at a glance. The Westinghouse exhibit, as we have said, illustrates how the brake works on a train exactly as in practice, only instead of the brake operating on a train stretched out on a line of rails it operates on one, so to say, rolled up into a coil, which is obviously of the same length, and on which the action of the brake is much more easily surveyed.

To the left will be seen the main reservoir—of extra size in this instance—usually placed beneath the foot-plate of the locomotive, and having attached to it the Westinghouse air compressor, which is worked by steam from the main. In the centre of the table is the driver's brake valve for applying and releasing the brake, and above it are shown gauges to indicate the pressure in the train pipe, auxiliary reservoir, and brake cylinder respectively. Upon the walls are hung an excellent set of diagrams. As shown in the illustration there is also a very neat working model of a carriage frame fitted complete with all the parts one-quarter size, exactly as erected on a carriage in actual service. We have at various times described the action of the Westinghouse brake, but it will perhaps be well again to explain its operation.

Air compressed by the pump on the locomotive to, say, 70 lb. or 80 lb. to the square inch, fills the main reservoir on the engine, and flowing through the driver's brake valve and main pipe, also charges the supplementary reservoirs—seen lying horizontally beneath the cylinders in the drawing—throughout the train. When a train is running, uniform air pressure exists throughout its length; that is to say, the main reservoir on the engine, the pipe from end to end of the train, the triple valves, and the supplementary reservoir, are all charged ready for work, the brake cylinders being empty and the brakes off. The essential principle of the system is that maintaining the pressure keeps the brakes off; but letting the air escape from the brake pipe purposely, or accidentally, instantly applies them. It follows, therefore, that the brake may be applied by the driver or any of the guards, or, if necessary, by a passenger, as well as by the separation of a coupling or the failure or injury to a vital part of the apparatus, whether due to an accident to the train or to the brake; and as the brake on each vehicle is complete in itself and independent, should the apparatus on any one carriage be torn off the brake will nevertheless remain applied for almost any length of time upon the rest of the train. By closing a small tap on the branch leading from the train pipe to the triple valve, the brake on any vehicle can be cut out of the system. A release valve is also placed upon each cylinder, so that in the event of the brakes being applied by the separation of the train, or the breaking of a pipe, or when the locomotive is not attached, they can be released by allowing the air to escape from each brake cylinder direct. This release valve can be opened from either side of the carriage by pulling a cord, and as it closes automatically there is no fear of its remaining open after being used. On the brake being applied, by simply moving the handle of the driver's brake valve to the right, the piston-rods—which in ordinary use are attached to the rigging for applying the blocks to the wheels—are seen to

rise simultaneously all along the train, and with a uniformity which is remarkable. Upon turning the handle to the left again they as simultaneously fall; but this is not all. The brake can be applied with the greatest nicety by simply regulating the amount of air allowed to escape from the driver's valve, as we have ourselves witnessed on the gauge connected to the brake cylinder. By decreasing the pressure in the brake pipe a few pounds only, the piston-rods slightly emerge, sufficiently perhaps to take up the slack of the brake gear without bringing any force to bear upon the wheels; a little more, and the blocks will rub gently, sufficiently to steady a train, say, on taking a curve. A further reduction in the train pipe will give, perhaps, enough brake force for an ordinary station stop, in making which only a small quantity of air need ever be used; and so on by increments up to the full application of which the brake is capable, and which, of course, could have been applied in the first instance if necessary.

It cannot be denied that in performing what has been illustrated—not only at the Exhibition, but in daily practice all over the world—Mr. Westinghouse has accomplished a great feat. He has contrived, in fact, without the doubtful aid of electricity, to bring a power to bear at a point removed a long way from the operator as quickly as at one close to him, and has succeeded in making a large number of brakes work like one. The great object which Mr. Westinghouse set himself to achieve was to bring the requisite force against the wheels over the greatest length of train in the shortest possible time, and his success is unquestionable. Quickness of application, in fact, is everything in a brake, for reasons which probably require no explanation. It is not, as some have thought, a question of getting more force—so long, that is, as there is sufficient—but of celerity in bringing the requisite power into action. It is obvious that whatever may be the means of getting the power employed, or however objectionable such means may be, one system can sooner or later bring the same force to bear as another. It is the delay in doing so, however, which virtually renders certain systems impracticable for general use, and which, if used at all, can only be employed at the sacrifice of that instantaneous and simultaneous action which we have shown is so essential. It must not be understood that 400ft. is the limit on which the Westinghouse brake can work satisfactorily, since it is frequently used on passenger trains in this country from 600ft. to 900ft., or even 1000ft. in length, and it has been worked on a freight train in the United States 2000ft. long. In the exhibit before us, which, however, is more than an average train, the length was limited by the space available. We are particular in drawing attention to these points since brakes which may, in some respects, be well adapted for short, are quite incapable of giving good results on long trains.

So far we have dealt with what may be actually seen and substantiated at the Exhibition, and it will be only right now, perhaps, to devote some space to explaining how such admirable results are accomplished. Broadly stated, these are due to the use of high pressure and the device called the triple valve in connection with local stores of power. Originally, as is well known, the Westinghouse brake was non-automatic—that is to say, the power for working the brakes was stored upon the engine only, and when it was desired to apply them the compressed air had to pass from the reservoir on the engine through a long pipe, and thence into the brake cylinders on each carriage. Although this appliance answered remarkably well up to a certain point, it became clear that for the worst types of accidents, and for coping with the greatest emergencies, something further was required. The principle was clearly defective, for not only was there loss of valuable time in getting the brake on after the necessity had arisen, but in case of separation of the train or damage to the apparatus, both the front and rear portions were deprived of their brake power, and if the brake had already been applied and injury ensued, it at once came off. Further, the guard was unable to apply the brake, and there was the liability from various causes of the brake being rendered entirely inoperative without warning to the driver, which was, perhaps, as serious a defect as any, for probably the chief requirement in a life-saving appliance is that it should be trustworthy. It will, therefore, at once be understood how important was the next step taken towards remedying the above defects, when each vehicle was equipped with an auxiliary reservoir carrying its own store of power for its operation, instead of, as hitherto, the power being carried on the engine only. By maintaining the pressure to keep the brakes off, the apparatus at once acquired self-acting properties, and also became available for use by the guards as well as the driver, and in case of an injury or defect, which would have previously rendered it useless without warning, it was made certain in action and became a most effective tell-tale of its own condition. This was certainly a great step, but important as were the improvements which followed this change of principle, it was found that the full advantages could not be enjoyed on trains of more than a certain moderate length, since the defect of slow action was still retained. The arrangement in question, which is virtually the same as that now used on several other systems of brakes, consisted of a cylinder, of which one end was in connection with a reservoir or its equivalent, and the other attached to the train pipe, the piston being kept in equilibrio by the power being maintained on both sides of it, and the brakes thereby held out of action. Before the power on the one side of the piston and in the reservoir could be exerted with all its force, it is clear that that on the other side had to be entirely destroyed, and consequently the whole of the air contained in a considerable portion of a large cylinder on every carriage, as well as that in the train pipe, had to be exhausted before the brakes could be fully applied. This took up too much valuable time, and entailed the use of a large quantity of air. A further important objection was the necessity of employing a stuffing-box for the piston-rod, which it was essential should be kept air-tight—a result almost impossible of attainment on large numbers of carriages. The great object, therefore, to which Mr. Westinghouse now directed his attention, was the saving of time and air, and before long the triple-valve—the greatest improvement of all—was invented. This beautiful device consists simply of a small piston carrying with it a slide valve, which can be moved up or down by increasing or decreasing the pressure in the brake pipe, and it has the following triple functions: (1) To charge the auxiliary reservoir with air, which (2) is admitted to the cylinder when the brakes are applied, and (3) allows the air to escape to the atmosphere when the brakes are released. By carrying the store of power in the separate reservoir only, instead of in the reservoir and brake cylinder as well, it follows that the brakes are now held off by maintaining the equilibrium on the two sides of the triple valve piston, the reservoir pressure being above and that of the train pipe below; and it is further clear that, even for the full application of the brakes, there is no object, with such a device as the triple valve, in reducing the pressure in the brake pipe below that resulting from the expansion of the air from the reservoir into the brake cylinder. Thus, if these two were the same size, 80 lb. in the reservoir would be reduced by expansion to 40 lb. in both, and a reduction in the brake pipe to less than 40 lb. would, therefore, be so much waste. By making the reservoirs, however, five times the capacity of the space to be filled in the cylinders, the full pressure of the former is available in the latter when only one-fifth of the air, in the brake pipe alone, has been let out, and this amounts in practice to less than the contents of a half-inch pipe—that is for the full application of the brake; but good, ordinary stops can be made with even, say, one-third of this amount.

Not only, then, is the automatic action secured by the triple valve, but in addition (*a*) instantaneous and simultaneous application is produced, and the brake made available on long trains. This results, as we have shown, from the fact that the contents of the train pipe only are operated upon by the driver, and therefore that a very small quantity of air at high pressure has to be moved in order to bring the triple valves into action. (*b*) Great economy of air is effected, since only a small portion of that contained in the train pipe is used in addition to the air which enters the brake cylinders. (*c*) The use of piston-rod packing is entirely avoided, because air is admitted only on one side of the piston. From what has been said it will be quite understood that while the triple valve is by no means required for procuring automatic action, some such device is essential for securing the best possible results. Moreover, it appears to be considered by many that the benefits of automatic action can only be experienced when trains break in two, but from the explanations we have given it will be understood that this feature, when carried out in the way described, entails many other very important advantages which are entirely wanting in brakes constructed on the non-automatic system.

Perhaps the most interesting feature in this exhibit is the portion standing between the main reservoir and the train in our illustration, and which consists of a separate cylinder, reservoir, and triple valve, in connection with a driver's brake valve. A triple valve in section is attached to another working valve, and the pistons of both being connected by a small wire, the movements of the working valve admit of being watched in the section. In this ingenious way the working of the triple valve, and therefore of the brake, is illustrated, and the truth of Mr. T. E. Harrison's words realised, when, in alluding to this piece of mechanism, he stated, "There is nothing about it that can justify the term complication; on the contrary, it is a model of ingenuity and simplicity." The Westinghouse Brake Company claim the following as the broad points of excellence in their system, in addition to the general feature of automatic action:—That it is instantaneous and simultaneous in action; that the surfaces are small and the parts light; that the brake can be operated on the longest trains; that power may be stored upon a train for use in an emergency, ready to be applied by the guards or automatically—a feature of great value in case an unfitted engine is attached, or a vehicle not having the same brake is inserted between the engine and train; that the braking power admits of perfect graduation; that the brake upon any one carriage can be isolated from the rest of the train; that carriages can be uncoupled without applying the brakes, and therefore shunting and other operations are not interfered with; that by this system the brake blocks may be kept a considerable distance from the wheels; that the system is most convenient and useful for "slipping" portions of trains; and that the brakes are not liable to be influenced by frost.

We have left ourselves but little room to refer to various details of the brake, such as the air pump, coupling, &c., or to the signal communication which is shown attached to the board which runs overhead, and is supposed to represent the roof of a carriage. Upon the Continent considerable use is being made of this signal system. All those companies using the Westinghouse brake have now the opportunity of adopting a signal communication worked by the compressed air, no other connection between vehicles than the ordinary brake couplings being necessary. It is claimed that it affords the means of producing the following results:—(1) The driver is warned by a whistle sounding on the engine; (2) the train is stopped by the brake should the warning be disregarded; (3) the apparatus cannot be used without the compartment from which the signal was given being detected; (4) the guard can signal to the driver by a code without applying the brake.

There is also shown a train-pipe indicator, invented by Mr. Albert Kapteyn, manager of the Westinghouse Brake Company, which is a very ingenious and novel instrument for enabling the engine-driver to ascertain the number of vehicles under his control by the brake. When trains are re-made at junctions, &c., sometimes vehicles are inserted which are not fitted with any brake apparatus, or fitted only with that of a different system, but the driver can by this means tell exactly, by testing at any point of the journey, what proportion of the train he can rely upon for stopping purposes; the number of vehicles being indicated on a gauge before him.

Two statements exhibited at either end of the stand are worthy of attention, for they show the widespread popularity of the apparatus we have been describing. Up to the 31st March last the increase of the automatic system in four years and eight months amounted to 77,046 sets for engines, carriages, and wagons, while the total number of Westinghouse brakes in use in all parts of the world on the same date was no less than 106,572 sets, and we are informed that this number has since been largely increased. The equipment of freight trains in the United States now forms a large portion of the business of the Westinghouse Air Brake Company in Pittsburg.

Strong as is the feeling on the brake question, there is, we venture to think, hardly one who will not congratulate Mr. Westinghouse on the success which has crowned his efforts, or who will deny him the credit he undoubtedly deserves of having resolutely forced this subject to the front, and to a large extent taught us all we know about brakes.

THE DESIGN OF SINGLE RIVETTED LAP JOINTS IN BOILERS.

By Professor R. H. Smith.

A steam boiler joint has two functions to perform; (1) to transmit tensile stress; (2) to prevent leakage of steam. In performing the first function a call is made upon the strength of the joint; the due performance of its second function depends on its stiffness. In all sorts of joints there is great and complicated inequality in the distribution of stress through the material. This makes it difficult to calculate the maximum occurring stress, on which maximum, of course, depends the strength of the joint. It is comparatively easy to calculate the average stresses that arise in the various sections throughout the joint; but no theory that takes account of these average stresses only can be looked on as at all rational or trustworthy for the practical purposes of design.

The gradual and large decrease of the modulus of elasticity occurring in metal as the stress rises above the "limit of elasticity" towards the breaking stress, results in a very different relative distribution of stresses under a load near the breaking load than that existing under much lower stresses, such as may be fairly reckoned as under the "limit of elasticity," however that term may be defined. It is, therefore, wrong and delusive to attempt to calculate the stresses actually occurring under "working loads" from the results of experiments on "breaking loads." Such a calculation would probably in all cases make the maximum stress under the working load appear much less than it really is, because the general effect of increasing the load so as to produce very heavy stresses must be always, or nearly always, in the direction of producing greater uniformity of distribution of load over the whole area of each section. It seems, therefore, to the writer much more reasonable, whenever practicable, to design joints according to the results of a careful and detailed theoretic calculation of the maximum stresses under light loads, assuming in such calculation a constant proportion between similar stresses and strains and investigating according to this assumption as accurately as possible the exact distribution of the stresses. The maximum stresses thus calculated are to be compared with the breaking strengths of the material in tension, compression, and shear, as found by direct experiments on these primary qualities. A suitable factor of safety being adopted, a formula can then be framed for dimensioning the joint.

Evidently the same reasoning will equally well apply, not only to joints, but to all elements of construction subjected to working loads that do not stress the material beyond the limits of elasticity. The writer believes that this is the proper method of attacking most problems in design. The present paper records an attempt made some time ago to apply this method to the design of single-rivetted lap boiler joints.

The spacing of the rivets should be designed in accordance with the condition that the joint should prevent leakage of steam. If we look on the plate as a continuous beam, with equal spans supported at the rivets and loaded with the uniformly distributed load due to the steam pressure, we find that the deflection of such a beam at mid-point of each span—*i.e.*, midway between the rivets—is proportional to $\frac{p\,P^4}{t^3}$, where p is the steam pressure—in pounds per square inch, P the pitch, and t the plate thickness. If equal steam tightness be demanded of all boilers, this will probably be insured by making this rise of the plate between the rivets the same in all cases. Doing so, we obtain the rule for proportioning the pitch to the thickness, namely—

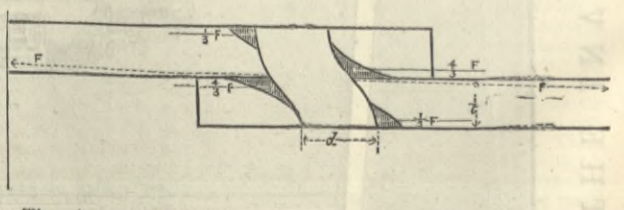
$$P \propto \frac{t^{\frac{3}{4}}}{p^{\frac{1}{4}}}.$$

If we consider that to ensure tightness under high pressure a less rise is permissible for the higher pressure, and make the rise proportional to the reciprocal of the pressure, we would obtain—

$$P \propto \frac{t^{\frac{3}{4}}}{p^{\frac{1}{4}}}.$$

The former supposition is adhered to here as giving results consistent with practical experience, although perhaps a formula lying between the above two would appear most rational. In the tables at the end of this paper are given the results of the first formula with the following two factors—

$$\left.\begin{aligned} P &= 9\tfrac{1}{2}\,\frac{t^{\frac{3}{4}}}{p^{\frac{1}{4}}} \\ P &= 12\,\frac{t^{\frac{3}{4}}}{p^{\frac{1}{4}}} \end{aligned}\right\} \begin{aligned} &P \text{ and } t \text{ in inches.} \\ &p \text{ in pounds per square inch.} \end{aligned}$$



The above sketch shows in exaggerated fashion the sort of bending the rivet undergoes when the pull F through the joint is not so great relatively to the stiffness of the joint as to bend the plate edges so as to pull the two plates in line with each other. About ⅝ of the length t of the rivet (the plate thickness $=t$), or rather more than ⅔, is under pressure on the side next the plate edge, and between ¼ and ⅛ t length under an opposite pressure on the opposite side. The shaded triangular spaces are diagrams showing the distribution of the intensity of these rivet pressures. The whole pressure on the side next the plate edge is ⅔ F, and its maximum intensity about four times what

would be produced if F were uniformly distributed over the length t, that is, about $\frac{5\,F}{t\,d}$. The maximum bending moment on the cross section of the rivet is about $\frac{4}{27}\,F\,t$, and occurs at rather less than $\frac{1}{3}\,t$ distance from the joint surface. Equating this to the resistant bending moment of the rivet, using the ordinary formula for a beam of circular section, and writing $F=(P-d)\,t\,f$, where f is the average tensile stress on the plate section between the rivet holes, we find:—Tensile and compressive stresses on cross section of rivet produced by bending each $=$ say $f^1=$ about $1\frac{1}{2}\,\frac{(P-d)\,t^2}{d^3}\,f$.

The shear stress at the centre of the section of the rivet is $\frac{4}{3}$ the average over the whole section, and therefore equals $\frac{16}{3\pi}\,\frac{F}{d^2}$. It is generally admitted that a safe shear stress in iron is about $\frac{4}{5}$ the safe tensile stress, so that what may be termed the tension equivalent of the above shear stress $=$ say $f^{11}=\frac{5}{4}\times\frac{16}{3\pi}\times\frac{F}{d^2}=2{\cdot}12\,\frac{(P-d)\,t}{d^2}f$. This shear equivalent is greater and more dangerous than the stress f^1 produced by bending so long as $d>{\cdot}71\,t$. As the rivet diameter has always a greater ratio than this to the plate thickness in boiler work, we must design these joints in view of the shear stress, and not in view of the bending moment on the rivet section.

If now the maximum tensile stress on the plate section is q times the average between the rivet holes, we may equate

$$q\,f=2{\cdot}12\,\frac{(P-d)\,t}{d^2}\,f$$

or

$$d=\frac{1{\cdot}06}{q}\left\{\sqrt{t^2+\frac{2\,q}{1{\cdot}06}\,P\,t}-t\right\}$$

This equation is, with suitable constants, identical with that used by Professor Kennedy for the calculation of the pitch. To show the identity, Professor Kennedy's formula may be written

$$P=\frac{q}{2{\cdot}12}\,\frac{d^2}{t}+d.$$

For boiler joints, however, I have endeavoured to show that the pitch should be designed so as to give steam tightness, and the diameter of rivet is then to be calculated for strength according to the above formula. The ratio q depends on the ratio of rivet diameter to pitch. I have calculated the following values, the theory on which the calculation is based not pretending to be more than a fairly close approximation to the truth:—

$\frac{d}{P}$	q	$\frac{1{\cdot}06}{q}$
·3	2·05	·514
·4	2·54	·417
·5	3·21	·330

In connection with the two factors $9\frac{1}{2}$ and 12 in the formulas for the pitch previously given, I have used the two values of $\frac{1{\cdot}06}{q}={\cdot}42$ and ·4 in calculating the following table of dimensions. These tables are, therefore, constructed according to the following two pairs of formulas:—

1st Table.

$$P=9\tfrac{1}{2}\,\frac{t^{\frac{3}{2}}}{p^{\frac{1}{2}}}$$

and

$$d={\cdot}42\left\{\sqrt{t^2+4{\cdot}76\,P\,t}-t\right\}$$

2nd Table.

$$P=12\,\frac{t^{\frac{3}{2}}}{p^{\frac{1}{2}}}$$

$$d={\cdot}4\left\{\sqrt{t^2+5\,P\,t}-t\right\}$$

The first of these tables gives results very closely in agreement with what I have been accustomed to look on as the best boiler practice except for very small and very large plate thicknesses. Very small rivets cannot be used owing to their heads snapping off during cooling after being closed. Very large rivets cannot be used, owing to the mechanical difficulty of perfectly closing them. There seems to be now a tendency to use wider pitches, and the second table will probably better represent this more recent practice.

If in the formula for the pitch account be taken of the probable fact that greater closeness of joint is required to prevent leakage of the higher pressure steam, the factor 20 in the formula

$$P=20\,\frac{t^{\frac{3}{2}}}{p^{\frac{1}{2}}}$$

will give good results. This should be used along with the latter of the two formulas previously given for d, namely

$$d={\cdot}4\left\{\sqrt{t^2+5\,P\,t}-t\right\}$$

The results of this pair of formulas are given in the third table. All three tables are calculated for the four pressures 50, 100, 150, and 200 lb. per square inch. All dimensions are in inches.

SINGLE-RIVETTED LAP JOINTS FOR BOILERS.

P = pitch; t = plate thickness; d = rivet diameter; all inches.
p = steam pressure lbs. per square inch.

Table I.

Formulæ $\begin{cases} P=9{\cdot}5\,t^{\frac{3}{2}}\,p^{-\frac{1}{2}} \\ d={\cdot}42\left\{\sqrt{t^2+4{\cdot}76\,t\,P}-t\right\} \end{cases}$

$p=50$.

t.	$\frac{1}{4}$in.	$\frac{5}{16}$in.	$\frac{1}{2}$in.	$\frac{5}{8}$in.	$\frac{3}{4}$in.	$\frac{7}{8}$in.	1in.
P	1·26	1·71	2·12	2·51	2·88	3·23	3·57
d	·42	·59	·76	·91	1·07	1·22	1·36
$\frac{P-d}{P}$	·67	·65	·64	·64	·63	·62	·62
			$p=100$.				
P	1·06	1·44	1·79	2·11	2·42	2·72	3·00
d	·38	·53	·66	·82	·96	1·09	1·22
$\frac{P-d}{P}$	·64	·63	·63	·61	·60	·60	·59
			$p=150$.				
P	·96	1·30	1·61	1·91	2·19	2·45	2·71
d	·36	·50	·64	·77	·90	1·02	1·15
$\frac{P-d}{P}$	·62	·62	·60	·60	·59	·58	·58
			$p=200$.				
P	·89	1·21	1·50	1·78	2·04	2·29	2·53
d	·34	·48	·61	·74	·86	·98	1·10
$\frac{P-d}{P}$	·62	·60	·60	·60	·58	·57	·56

Table II.

Formulæ $\begin{cases} P=12\,t^{\frac{3}{2}}\,p^{-\frac{1}{2}} \\ d={\cdot}4\left\{\sqrt{t^2+5\,t\,P}-t\right\} \end{cases}$

$p=50$.

t.	$\frac{1}{4}$in.	$\frac{5}{16}$in.	$\frac{1}{2}$in.	$\frac{5}{8}$in.	$\frac{3}{4}$in.	$\frac{7}{8}$in.	1in.
P	1·60	2·16	2·68	3·17	3·64	4·08	4·51
d	·47	·67	·85	1·03	1·21	1·38	1·54
$\frac{P-d}{P}$	·70	·69	·68	·67	·67	·66	·66
			$p=100$.				
P	1·34	1·82	2·26	2·67	3·06	3·43	3·80
d	·43	·60	·77	·93	1·09	1·24	1·39
$\frac{P-d}{P}$	·68	·67	·66	·65	·64	·64	·63
			$p=150$.				
P	1·21	1·64	2·04	2·41	2·76	3·10	3·43
d	·40	·57	·72	·88	1·02	1·16	1·30
$\frac{P-d}{P}$	·67	·65	·64	·64	·63	·62	·62
			$p=200$.				
P	1·13	1·53	1·90	2·24	2·57	2·89	3·19
d	·39	·54	·69	·84	·98	1·11	1·25
$\frac{P-d}{P}$	·66	·64	·63	·63	·62	·61	·61

Table III.

Formulæ $\begin{cases} P=20\,\frac{t^{\frac{3}{2}}}{p^{\frac{1}{2}}} \\ d={\cdot}4\left\{\sqrt{t^2+5\,P\,t}-t\right\} \end{cases}$

$p=50$.

t.	$\frac{1}{4}$in.	$\frac{5}{16}$in.	$\frac{1}{2}$in.	$\frac{5}{8}$in.	$\frac{3}{4}$in.	$\frac{7}{8}$in.	1in.
P	1·63	2·21	2·74	3·24	3·72	4·17	4·61
d	·48	·68	·86	1·05	1·22	1·39	1·56
$\frac{P-d}{P}$	·71	·69	·69	·68	·67	·67	·66
			$p=100$.				
P	1·26	1·70	2·11	2·50	2·87	3·22	3·56
d	·41	·58	·74	·90	1·05	1·19	1·33
$\frac{P-d}{P}$	·675	·66	·65	·64	·63	·63	·62
			$p=150$.				
P	1·08	1·46	1·82	2·15	2·46	2·76	3·05
d	·375	·53	·68	·82	·95	1·08	1·21
$\frac{P-d}{P}$	·65	·64	·63	·62	·61	·61	·60
			$p=200$.				
P	·97	1·31	1·63	1·93	2·21	2·48	2·74
d	·85	·495	·63	·76	·89	1·01	1·14
$\frac{P-d}{P}$	·64	·62	·61	·61	·60	·59	·58

Robert H. Smith.

Mason College, Birmingham.

DOUBLE-RIVETTED LAP JOINTS FOR BOILERS.

P = longitudinal pitch; P^1 = diagonal pitch; t = thickness of plate; d = diameter of rivet; all in inches.
p = steam pressure lbs. per square inch.

Table I.

Formulæ $\begin{cases} P=18\,t^{\frac{3}{2}}\,p^{-\frac{1}{2}} \\ P^1=\frac{2}{3}\,P+\frac{1}{8}\,d \\ d={\cdot}2\left\{\sqrt{t^2+10\,t\,P}-t\right\} \end{cases}$

$p=50$.

t.	$\frac{1}{4}$in.	$\frac{5}{16}$in.	$\frac{1}{2}$in.	$\frac{5}{8}$in.	$\frac{3}{4}$in.	$\frac{7}{8}$in.	1in.
P	2·40	3·24	4·02	4·75	5·46	6·12	6·76
P^1	1·75	2·37	2·94	3·49	4·02	4·51	5·00
d	·44	·63	·80	·97	1·14	1·30	1·46
$\frac{P-d}{P}$	·81	·80	·80	·80	·79	·79	·79
			$p=100$.				
P	2·01	2·73	3·39	4·00	4·59	5·14	5·70
P^1	1·48	2·01	2·50	2·96	3·40	3·82	4·24
d	·43	·57	·73	·88	1·03	1·18	1·32
$\frac{P-d}{P}$	·79	·79	·79	·78	·78	·77	·77
			$p=150$.				
P	1·81	2·46	3·06	3·61	4·14	4·65	5·14
P^1	1·34	1·82	2·27	2·69	3·08	3·47	3·85
d	·38	·54	·69	·83	·97	1·11	1·25
$\frac{P-d}{P}$	·79	·78	·78	·77	·77	·76	·76
			$p=200$.				
P	1·69	2·29	2·85	3·36	3·85	4·33	4·78
P^1	1·25	1·70	2·12	2·50	2·88	3·25	3·59
d	·36	·52	·66	·80	·94	1·07	1·20
$\frac{P-d}{P}$	·79	·78	·77	·76	·76	·76	·75

The preceding paper was sent three or four months ago to the Secretary of the Institution of Mechanical Engineers as a contribution to the discussion that took place after the presentation of the report by the Research Committee on Rivetted Joints. The writer was unable to attend the meeting so as to make his contribution by word of mouth. The secretary has, after an interval of three months, returned it to the writer, informing him that the Council cannot accept it because of its "purely theoretical character." The paper was evidently referred by the Council for criticism to some one who has marked it with various pencillings, one of which conclusively proves the critic to be unacquainted with the veriest elements of algebra, because it questions the "identity" of two equations which are different in form but are identical in the familiar algebraic sense of the term.

What is "pure theory?" Those members of the Institution of Mechanical Engineers who have read their own "Proceedings" must have found in them many papers of a more "purely theoretical" character than the above, whatever meaning be attached to the phrase. In April, 1881, there was read a paper on this very subject of rivetting by Baron Clauzel, which may compete with any that was ever read before a professional audience in the characteristic of being "purely theoretic." Some persons think of "theory" as being necessarily the product of the imagination assisted by logic; that is, that the theorist starts with "assumptions" unverified by observation or experiment, and deduces by reasoning conclusions which may happen to be true if the assumptions accidentally happen also to be true. Things of this nature have been produced, unfortunately, and have been called theories. They are, of course, wholly worthless. According to a more rational acceptation of the phrase, a "theory" is nothing more than a systematic assortment and rational explanation of facts known by experience of either the experimental or the observational kind. Such unspeculative theory is in the highest degree useful, and has always been recognised as useful by intelligent men. By its help *new* results *which are true* have often been discovered. Provided the statements of fact on which such theory is based be well ascertained to be accurate, and provided the reasoning used in the assortment and manipulation of these facts be without fallacy or flaw of any kind, the new results are certainly true. But if they are true, they can in almost every case be verified by direct experience; and since none of us can be quite sure of avoiding errors in reasoning, it is always well to test by direct experience the new results of any theory, however well founded it be.

The Council have not rejected the above contribution to their discussion because of flaws in reasoning. If they interpret "theory" according to the first of the above conceptions, they are right in rejecting all "purely theoretic" papers; but, on the other hand, the above paper does not come under that definition because it is both founded on fact and tested by experience. If they adopt the latter conception, they cannot be complimented upon their intelligence in rejecting papers that are theoretical in that sense, nor upon their consistency, seeing that similar papers have been accepted by them before. The facts upon which the theory in the paper is founded are (*a*) the law connecting small stresses with small strains, *i.e.*, strains under the "elastic limit;" (*b*) the fact that the steam leaks through boiler joints if the rivets are spaced too far apart, and the average ratio between spacing and plate thickness, which is found by practical experience to prevent this leakage; and (*c*) the average ratio found between the shear and tensile strengths of rivet and plate iron. These are the bases from which conclusions are reached by reasoning, and these bases are well ascertained by experiment in testing machines and by the practical testing of finished boilers. The author has had a fair amount of personal experience in both these directions, but the experimental basis of the above paper is far wider than his own personal experience. The *test* of the "theory" consists in the comparison of the numerical results tabulated above with the dimensions used in the best boiler practice throughout the kingdom. The writer has made this comparison to some extent, and finds a marked agreement between his "theoretic" results and those obtained by long boiler-yard experience; and he will feel greatly favoured if the tables are further criticised by practised boiler makers.

Of course, the results in the above tables are not wholly consistent with the rules given in the Report of the Rivetted Joint Committee; but then it so happens that those rules *could* not be followed by boiler makers, except through a small range of plate thickness, for the simple reason that the joints so designed would not be *steam-tight*. The experimental results of the Committee are of the greatest possible value; that is admitted by the writer as cordially as by any one. Why are they not generally applicable to boiler work? Simply because the experiments were solely upon the *tensile strength* of rivetted joints, whereas in boiler work the joint must not only have tensile strength but must also prevent *leakage of steam*. They are directly applicable to such work as girders, where the joints have nothing to do besides transmitting the pull. But steam-tightness depends in a certain sense upon the closeness and *stiffness* of the joint, and no formula for the design of boiler joints can give the desired results as regards leakage that does not take into account the *steam pressure* in proportioning the pitch to the thickness of the plate.

The writer has not the smallest wish to depreciate the value of the work done by the Committee, nor does he maintain that their results are useless to help the rational design of boiler joints. He does maintain, however, that they alone are quite insufficient to guide such design; that a boiler joint *must* not be designed to secure only maximum tensile strength; and that so far as the Committee has intended its results to be directly applicable to boiler design, they are entirely wrong, and that common boiler-making and using experience proves them plainly to be wrong. Of course it is impossible to suppose that this is the reason why the writer's paper is rejected as "purely theoretical."

Robert H. Smith.

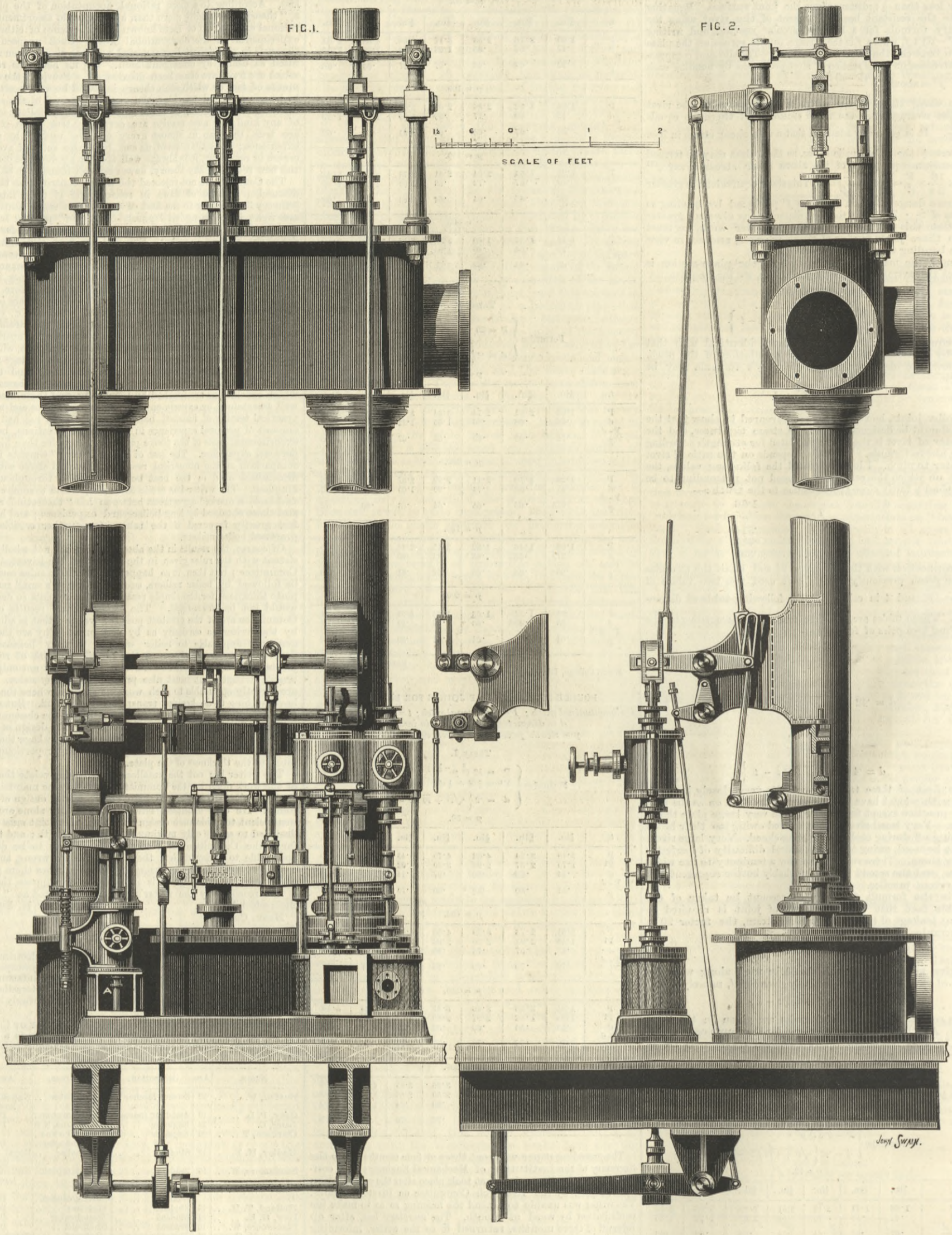
Mason College.

A Scandinavian Electrical Exhibition.—An electrical exhibition is being held at Gothenberg, at which all the principal electrical, telegraph, and telephone companies and manufacturers in Scandinavia are represented. One of the most interesting features is a continuous self-feeding waterfall worked entirely by electricity.

Science and Art Department of the Committee of Council on Education, South Kensington.—The following is a list of successful candidates for Royal Exhibitions, National Scholarships, and Free Studentships, May, 1885:—

Name.	Age	Occupation.	Address.	Award.
Burton, W.	22	Science teacher ..	Manchester ..	National Scholarship.
Gray, P. L.	19	Assistant master.	Southampton..	Do.
Lang, C.	22	Engineer	Johnstone, N.B	Do.
Clarkson, T... ..	20	Engineer	Pendleton, Manchester..	Do.
Hadley, H. E. ..	18	Student	Worcester ..	Royal Exhibition.
Scudamore, W. ..	16	Student	Northampton..	National Scholarship.
Lanchester, F. W.	16	Architect's assistant	Southampton..	Do.
Holland, T. H. ..	16	Student	Helston	Do.
Hey, H. E.	14	Student	Manchester ..	Do.
Blackmore, W. ..	18	Student	Sheffield	Do.
Bennie, H. O. ..	20	Engineer	Glasgow	Royal Exhibition.
Kelsall, W.	17	Student	Bradford	National Scholarship.
Sowerbutts, H. ..	17	Student	Manchester ..	Do.
Chattaway, F. ..	24	Chemist	Birmingham ..	Do.
Young, J.	23	Shoemaker	Belfast	Royal Exhibition.
Moulton, A. J. ..	20	Engineer's apprentice	Preston	Do.
Coote, H. C.... ..	17	Student	London	Do.
Unsworth, R. H..	20	Engineer	Pendleton, Manchester..	Do.
Woolhouse, S. H..	15	Student	Weaste, Manchester.. ..	Do.
Wilkinson, D. ..	21	Agent	Preston	Free Studentship.
Motteram, H. P...	19	Student	Small Heath, Birmingham.	Do.
Briscoe, A. E. ..	17	Machinist	Birmingham ..	Do.
Preston, O. J. ..	16	Student	Bristol	Do.
McKenzie, J. ..	20	Engineer	Glasgow	Do.
Coultas, P. C. ..	18	Student	Bristol	Do.

INVENTIONS EXHIBITION—DAVEY'S DIFFERENTIAL VALVE GEAR.



Messrs. Hathorn, Davey, and Co., Leeds, show at the Inventions Exhibition Davey's differential valve gear as applied to the working of Cornish pumping engines, the actual set exhibited being for a large engine now being erected at the Wolverhampton Waterworks. The gear itself is well known and has been frequently referred to in these columns; but as this particular arrangement contains several recent improvements, we make no excuse for bringing it again before our readers.

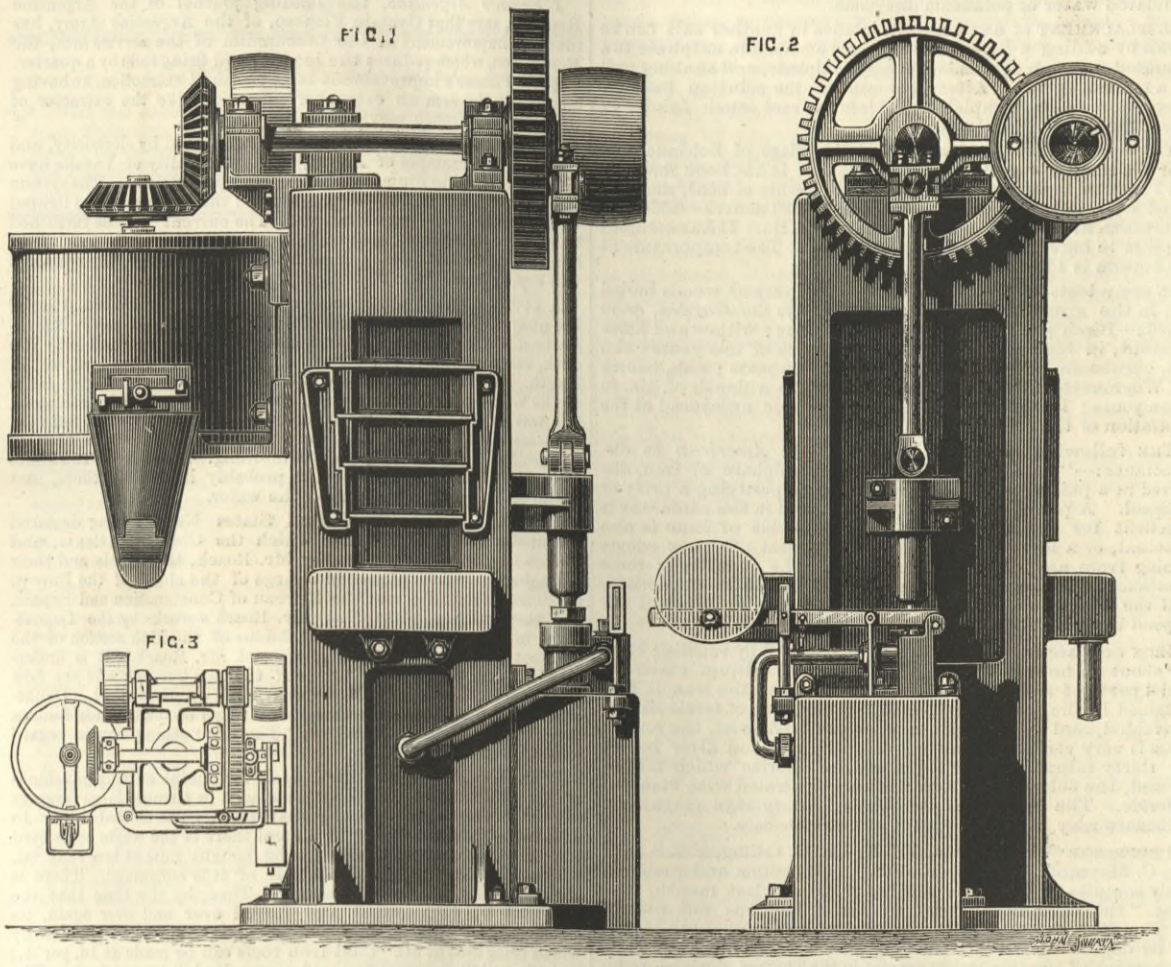
The first improvement is to enable the point of cut off to be varied. On referring to Fig. 2 it will be seen that there are two rocking shafts. On the upper one, which derives its motion from the main gear, are keyed the levers for opening and closing the steam valves. The lower shaft receives the motion of the piston on a reduced scale, and carries a lever which forms the fulcrum of that employed for opening the steam admission valve. In working, after the steam valve is opened and the engine has commenced a stroke, the motion communicated to the lower shaft removes the fulcrum of the lever, and permits the admission valve to drop. The point in the stroke at which this takes place may be varied by altering the position of the fulcrum.

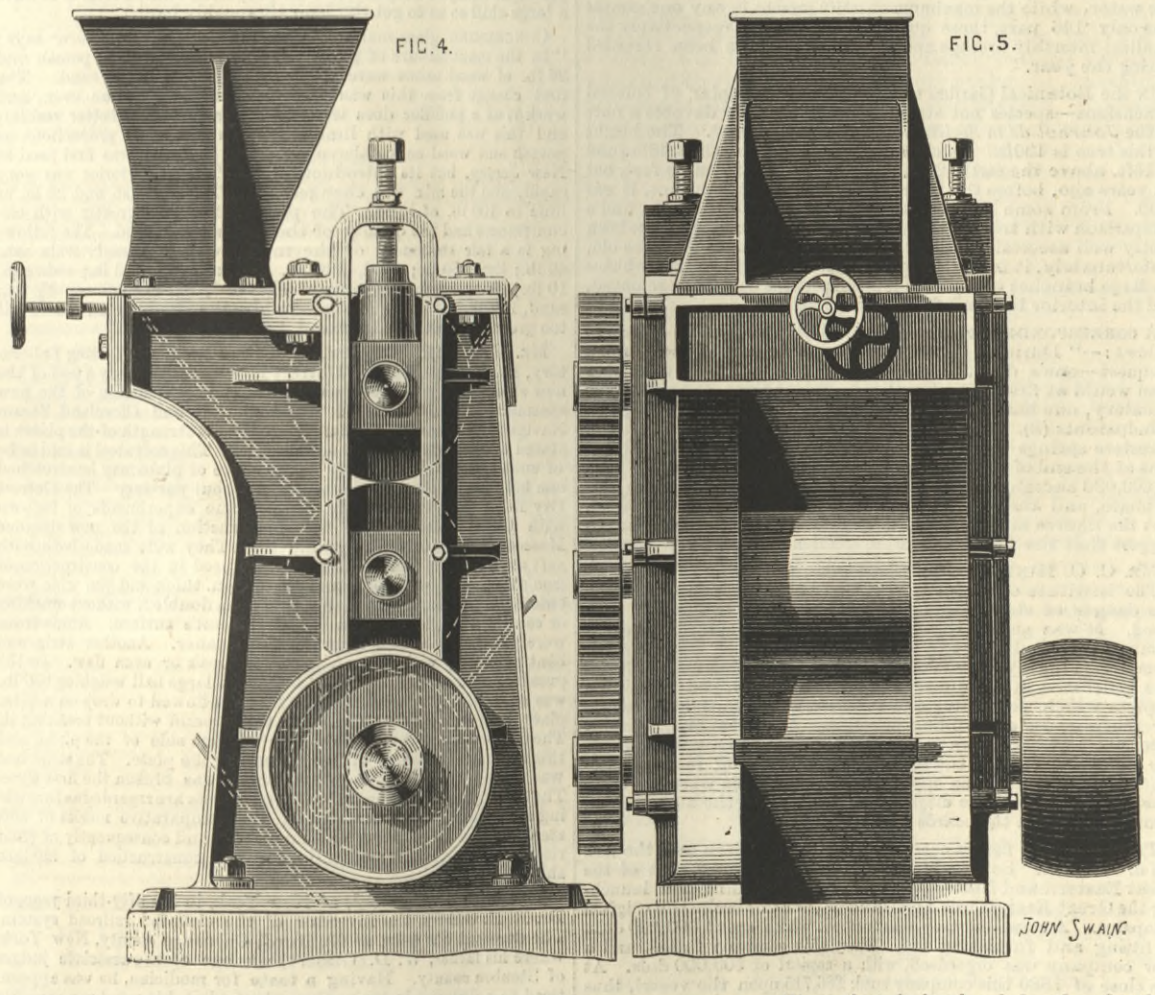
Another novelty is the addition of a trip gear, which causes the equilibrium valve to be dropped suddenly, when the engine, from loss of load, exceeds its normal rate of working. The arrangement of levers is precisely similar to that described for the steam valve, the fulcrum being held in position by means of a catch; but, in this case a cataract cylinder is employed for controlling the position of the fulcrum. In Fig. 1, A is the cataract cylinder, which is provided with an adjustable plug. Attached to its piston-rod is a small differential lever, one end of which receives the engine motion, while the other is held in position by means of a pair of spiral springs, a rod extending from the spring end to the catch which keeps the fulcrum of the equilibrium lever in position. When the engine is working, the plug of the cataract is adjusted until the resistance of the piston just overcomes the tension of the springs. A little increase in the speed, therefore, would cause the springs to be compressed and the catch to be released, so permitting the equilibrium valve to drop suddenly to its seat, or in other words, to be thrown out of gear.

British Manufactured Goods in New South Wales.—During 1884 New South Wales imported from British ports the following articles to the value mentioned:—Wearing apparel, £838,591; cement, £216,353; cutlery, £53,509; drapery, £3,217,159; earthenware and china, £163,526; furniture, £220,810; goldleaf, £1,309,862; hardware, £716,892; musical instruments, £179,294; boots and shoes, £581,820; books, £218,640; toys and fancy goods, £195,035; and watches and clocks, £129,019. These are only a few out of numerous items, not including the bulk of metal goods.

EXPORT OIL MILL.

MESSRS. ROSE, DOWNS, AND THOMPSON HULL, ENGINEERS.





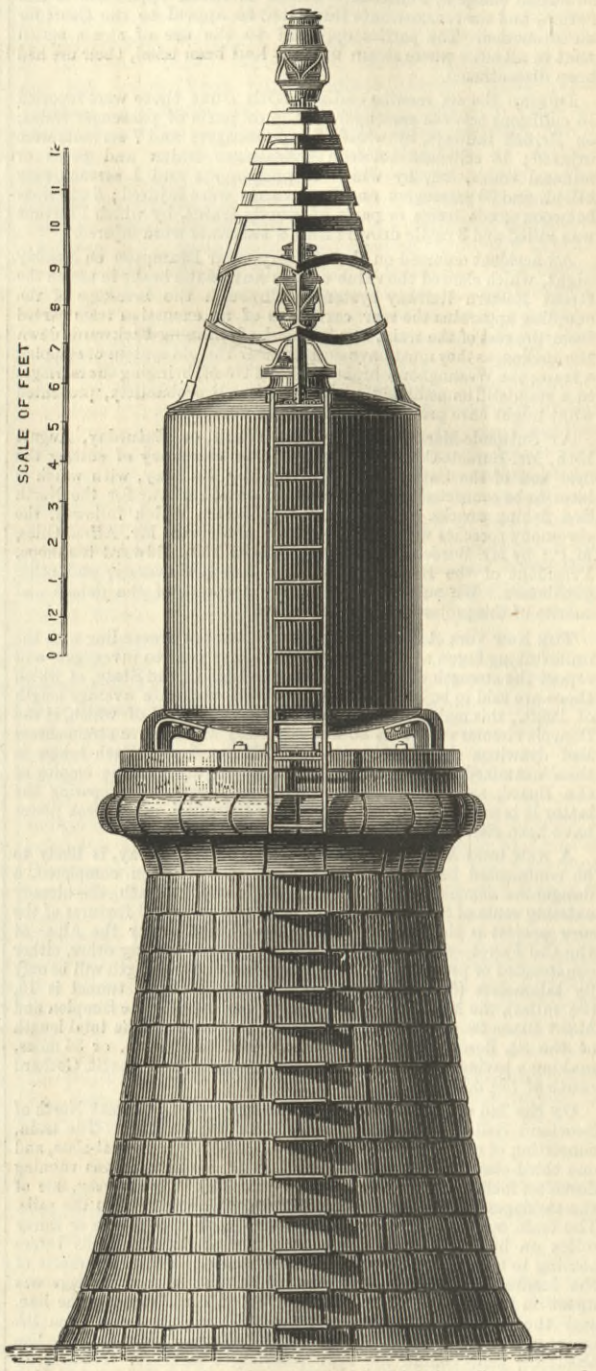
The roller process of crushing oil seeds with the special machines used in the process by Messrs. Rose, Downs, and Thompson, of the Old Foundry, Hull, its introducers in England, has been fully noticed in our issues of the 6th of May, 1881, and 3rd November, 1883. The last article described a small mill for export, but a still smaller kind of plant is required in some countries, where the oil mill is regarded as an agricultural implement. The export mill we illustrate was designed for this purpose. It is not generally known that seed-crushing is not effected, as in days gone by, by a single machine, and not unfrequently makers are asked for "a machine to make oil." No effectual process of extracting oil consists of less than three distinct operations :—(1) The crushing or grinding of the seed to break the oil cells. The machinery for this varies of course with the nature of the seed, which may be either a cocoanut or in grains as small as mustard. (2) The heating of the ground seed to facilitate the flow of oil and to coagulate the albuminous matters which otherwise mix with the oil. (3) The pressing, which is most effectually done by hydraulic power. The mill we illustrate is designed for all the smaller varieties of oil-seeds, such as linseed, rapeseed, sunflower-seed, or castor. For cotton-seed a modification in the rolls will give the required crushing power, while for olives small edgestones take the place of the rolls, and for cocoanut and palm kernels combinations of rolls and stones are used.

In the mill shown the seed is crushed between the rolls three in number, which give two crushings, the second under increased pressure. From these it is placed in the kettle, where it is heated by steam, or in the case of a mill worked by cattle, wind, or water-power by a furnace. From the opening of the kettle it is drawn in quantities sufficient for a cake into woollen bags, which are placed in the press. This holds five cakes about 18in. long and some 5 lb. weight when pressed. The pressure is given by a pump mounted on a cistern beside the press. This pump, which is of steel, is 1in. in diameter, and the lever of its safety valve is arranged to actuate a stop and relief valve, thus doing away with a stop valve. The plant as shown is calculated to treat 20 to 25 cwt. of oilseeds per day of eleven hours, and is, we believe, the smallest complete oil mill ever designed. It will be noticed that all the gearing is supported on the press, so that the erection is much simplified, a firm foundation being all that is required. The engine is one of Messrs. Rose, Downs, and Thompson's "Kingston" vertical type, and has a 7in. cylinder and 8in. stroke.

A New Process of Extracting Sugar from the Cane.—It is reported that Frobach has discovered a method of making sugar without crushing or pressing. According to this method the cane is cut into strips and the water is extracted by alcoholic vapour, which leaves the saccharine to be dissolved into liquid. The alcohol and sugar are filtered out by means of lime and chalk. It is claimed that this process of manufacture will add one-third to the production over and above any process now in use.

GAS BEACON GANTOCH ROCKS.

The gas beacon illustrated by the accompanying engraving has been erected for the Clyde Lighthouse Trust, on the Gantoch rocks, which are just off Dunoon in the Clyde, by Messrs. D. and T. Stevenson, the engineers to the Northern Lights Board. The superstructure, which is on Pintsch's system, consists of a receiver for oil gas under pressure, and a light strong support for the two powerful gas light lanterns. The light will burn thirty-five days with one filling of gas, and has two red lights. The whole of the lighting apparatus



has been constructed by the Pintsch's Lighting Company, of Clerkenwell-road, and the light illustrated is one of the many and various kinds, now being used by harbour and other authorities nearly all over the world, where lights capable of burning for several weeks or months at a time unattended, are of inestimable value to the shipping.

TENDERS.

HENLEY-ON-THAMES SEWERAGE.

List of tenders for the execution of sewerage works on the Shone hydro-pneumatic system, illustrated on page 140. Mr. Isaac Shone, C.E., Westminster-chambers, S.W., engineer.

Contracts Nos. 1, 2, and 4.—Pipe Sewers, Iron Mains, and Buildings

	£	s.	d.
John Jackson, Westminster	10,467	5	7
G. Munday and Son, London	10,252	10	3
W. T. Botterill, London	9,823	0	0
Beadle Bros., Erith	9,508	16	7
H. Young and Co., Pimlico	9,434	0	0
H. R. Trehearne and Co., Battersea	9,234	0	0
G. Gibson, Southall	9,187	17	11
W. Neave and Son, Paddington	9,075	0	6
J. W. and J. Neave, Leytonstone	9,029	17	3
S. and E. Collier, Reading	8,560	3	1
George Bell, Tottenham	8,447	18	3
J. W. Pickthall, Southampton	8,427	0	10
Thos. D. Ridley, Harwich—accepted	8,253	1	0
B. Cooke and Co., Battersea	7,781	13	0

Contract No. 3.—Air Compressing Machinery.

H. R. Trehearne and Co., Battersea	3,535	0	0
H. Young and Co., Pimlico	3,485	0	0
J. Warner and Sons, London	3,400	0	0
G. Scott and Son, London	3,348	0	0
Walker Bros., Wigan	3,200	0	0
Warsop and Hill, Nottingham	3,082	0	0
G. Waller and Co., London	3,010	0	0
E. Thomson, Leeds	2,987	15	0
Causer, Smith, and Co., Birmingham	2,964	0	0
J. Slee and Co., Earlstown, Lancashire	2,600	0	0
Thornewill and Warham, Burton-on-Trent	2,565	0	0
F. Silvester and Co., Newcastle, Staffordshire	2,370	0	0
Coalbrooke Dale Company, Shropshire	2,285	0	0
John Fowler and Co., Leeds	2,217	0	0
Pearce Bros., Dundee	2,200	0	0
W. and J. Yates, Blackburn	2,103	0	0
Grange Iron Company, Durham	2,075	0	0
Hartley and Arnoux Bros., Stoke-on-Trent	2,070	9	6
Galwey, Bainbridge, and Co., Warrington	2,064	0	0
Hughes and Lancaster, Chester—accepted	2,053	0	0
Geo. Kirk and Co., Stoke-on-Trent	2,021	0	0
Pratchitt Bros., Carlisle	1,997	0	0
J. Wolstenholme, Radcliffe, Lancashire	1,935	0	0

Progress of the Norwegian Navy.—Commander Wisbech, Director of Naval Ordnance in Norway, has been commanded to proceed to England and France, in order to report on the newest inventions of naval artillery. He will also purchase a 26-cm. gun for a new gunboat, probably in Essen, at a cost of £5000.

RAILWAY MATTERS.

The Board of Trade has just issued the return of railway accidents for the six months ending 30th June last. From this it appears that during that period 456 persons were reported to have been killed, and 3309 injured upon the railways and upon the premises of the companies. Accidents to trains, rolling stock, permanent way, &c., caused the death of nine persons and injury to 200.

The City Council of Concord, N.H., has authorised the use of steam motors on the street railroad running from Concord to the suburban village of Penacook. There is much opposition to this action, and the remonstrants threaten to appeal to the Court for an injunction. The parties opposed to the use of steam stated that in all cities where steam motors had been tried, their use had been discontinued.

During the six months ending 30th June there were reported 16 collisions between passenger trains or parts of passenger trains, on British railways, by which 34 passengers and 7 servants were injured; 18 collisions between passenger trains and goods or mineral trains, &c., by which 5 passengers and 1 servant were killed, and 60 passengers and 7 servants were injured; 8 collisions between goods trains or parts of goods trains, by which 1 servant was killed and 3 cattle drovers and 4 servants were injured.

An accident occurred on the railway near Brampton on Monday night, which showed the value of the automatic brake in use on the Great Eastern Railway system. Through the breakage of the coupling apparatus the rear carriages of an excursion train parted from the rest of the train, but instead of running backwards down the incline, as they must have done under the old system of stopping a train, the Westinghouse brake applied itself, bringing the carriages to a standstill immediately, and thus, in all probability, prevented what might have proved a very serious accident.

At Sutton-le-Marsh, on the East Wash, on Saturday, August 15th, Mr. Burdett-Coutts performed the ceremony of cutting the first sod of the Sutton and Willoughby Railway, with which is later to be connected the construction of a harbour for the North Sea fishing smacks. At the cold collation which followed, the ceremony speeches were made by the chairman, Mr. Alfred Giles, M.P.; by Mr. Burdett-Coutts; the Right Hon. Edward Stanhope, President of the Board of Trade; Lord Waveney, and other gentlemen. We purpose to give an account of the details and merits of this project in our next issue.

The New York Railroad Commissioners are proceeding with the undertaking begun at the beginning of last year to investigate and report the strength of every railroad bridge in the State, of which there are said to be 3500. Assuming the moderate average length of 100ft., this makes 66½ miles of bridging, for all of which, if the Board's circular request is honoured, they will receive strain sheets and drawings showing the leading dimensions. Each bridge is then examined on the spot by a bridge engineer in the employ of the Board, assisted by these drawings. Even in preparing the latter it is said, as might reasonably be expected, many weak places have been discovered and corrected.

A new trans-Alpine line, the St. Bernard Railway, is likely to be commenced before very long, and to be, when completed, a dangerous competitor for the through traffic with the already existing route of St. Gothard. One of the principal features of the new project is that the indispensable tunnel under the Alps—at the Col Ferret—will be very much shorter than any other, either constructed or proposed to be constructed. The length will be only 9½ kilometres (5¾ miles), while the St. Gothard tunnel is 15, (9¼ miles), the Mont Cenis 12, and those under the Simplon and Mont Blanc 20 and 19 kilometres respectively. The total length of the St. Bernard line will be but 138 kilometres, or 86 miles, making a saving between London and Brindisi over the St. Gothard route of 59½ miles.

On the 2nd of July a train left the road on the Great North of Scotland Railway between Wartle and Inveramsay. The train, consisting of engine and tender, one third-class, one first-class, and one third-class brake carriages, and rear brake van, was running down an incline of 1 in 177, about 1¼ north of Inveramsay, one of the carriages, probably the second from the engine, left the rails. The train was running at a speed of about twenty-five or thirty miles an hour, and the engine ran for about 235 yards before coming to a stand, when it was found that the leading wheels of the leading carriage were off the rails, the second carriage was upset on its right side, the third was off the rails across the line, and the rear vehicle—a brake van—had broken away from the train, and was lying against the bank on the left side of the line about 147 yards behind the rear passenger carriage. Fortunately no one was much hurt. The interesting part of the affair is that there seems to be no doubt that the train ran off on the inside of the curve because the intense heat of the sun had expanded the rails and distorted them.

During the six months ending June 30th, 435 failures of tires and 169 failures of axles took place on British railways. Of the 435 tires which failed, 9 were engine tires, 8 were tender tires, 2 were carriage tires, 7 were van tires, and 409 were wagon tires; of the wagons 307 belonged to owners other than the railway companies; 388 tires were made of iron, and 47 of steel; 11 of the tires were fastened to their wheels by Gibson's patent method, 6 by Mansell's, and 1 by Beattie's, none of which left their wheels when they failed; 410 by bolts or rivets, two of which left their wheels when they failed, and seven by other methods, one of which left its wheel when it failed; 16 tires broke at rivet holes, 57 in the solid, and 362 split longitudinally or bulged. Of the 169 axles which failed, 99 were engine axles, viz., 86 crank or driving, and 13 leading or trailing; six were tender axles, two were carriage axles, 60 were wagon axles, and two were axles of salt vans. Twenty-nine wagons, including the salt vans, belonged to owners other than the railway companies. Of the 86 crank or driving axles, 66 were made of iron and 20 of steel. The average mileage of 66 iron axles was 222,569 miles, and of 20 steel axles 202,715 miles.

Major Marindin's report upon an accident which occurred at Swadlincote, near Burton, on the Midland Railway, has now been published, and attention is once more directed to the dangerous and inefficient character of the Clayton so-called automatic vacuum, or better known as the "two-minute brake." On the 13th June a return excursion train consisting of engine and tender, No. 1440, and equal to sixteen coaches, arrived at Swadlincote. The engine and tender had steam brakes and vacuum apparatus; the vehicles were fitted and worked with the vacuum brake. The engine was detached to run round the train; the vacuum brake was applied but leaked off, and the train commenced to run back. The line being on a heavy falling gradient, a pair of runaway or catch points had fortunately been provided, or doubtless the carriages would have run back two miles to the junction with the main line and come into serious collision; as it was, the rear part of the train was thrown off the line at the points and came into collision with three goods wagons. There were about thirty passengers in the train, but they happened not to be in the vehicles which left the line. The facts of the case show at a glance the danger of the brake, and Major Marindin reports as follows:—"It must be remarked that when the engine was uncoupled the continuous brakes were fully applied throughout the train, but the whole of them must have leaked off in less than two minutes. I cannot consider," he continues, "that a continuous brake which leaks off in two minutes to be at all a satisfactory one, for it must frequently happen, as in this case, that it is desirable to hold a train by means of a continuous brake after the engine has been uncoupled, and in the case of a break-away, either on an incline when running or owing to a collision or other accident to the train, I can easily imagine that serious consequences might follow the release of the brakes so soon after their application. This slight accident should, in my opinion, be a warning against reliance being placed upon this brake under all eventualities."

NOTES AND MEMORANDA.

M. Dupre has succeeded in suppressing the nitrous vapours of the Bunsen battery by using a depolarising liquid, consisting of nitric acid in which 77 grs. potassium dichromate have been dissolved per litre. In contact with the zinc he employs either acidulated water or potassium disulphate.

Displacement of a salt from its solution by another salt can be shown by adding a little finely powdered ammonium sulphate to a saturated solution of ammonium copper sulphate, and shaking well for a minute or two. After a few moments the solution loses its colour more or less completely, and is in any case much fainter in colour than the original solution.

The deepest boring yet made is at the village of Schladebach, near the line between Leipzig and Corbetha. It has been made by the Prussian Government to test for the presence of coal, and was bored with diamond drills. Its depth is 1390 metres—4560ft.—its breadth at the bottom 2in., and at the top 11in. It has occupied 3½ years to bore, and cost a little over £5000. The temperature at the bottom is 118 deg. Fah.

In some tests made with small squares of various woods buried 1in. in the ground, the following results, says the *Garden*, were noted:—Birch and aspen decayed in three years; willow and horse chestnut, in four years; maple and red beech in five years; elm ash, hornbeam, and Lombardy poplar, in seven years; oak, Scotch fir, Weymouth pine, and silver fir decayed to a depth of ½in. in seven years; larch, juniper, and arbor-vitæ were uninjured at the expiration of the seven years.

The following are given by the *Scientific American* as disinfectants:—"Two pounds of copperas, or sulphate of iron, dissolved in a pail of water, will greatly assist in purifying a privy or cesspool. A pound of nitrate of lead dissolved in the same way is excellent for sinks, drains, or vaults. Chloride of lime is also effectual, or a layer of charcoal dust will prevent offensive odours arising from any decomposing substance. The quantity of these substances will depend upon the amount of filth to be deodorised, and the length of time during which they will be effectual will depend upon local conditions."

Iron ores are conveniently and quickly assayed by roasting them for about an hour in a muffle with 20 parts of calcium carbonate and 4 parts of sodium carbonate—free from iron; the iron is thus obtained in the form of ferric oxide, the formation of ferric silicate is avoided, and any organic matter present is removed, the roasted mass is very readily soluble in hydrochloric acid, and after boiling for thirty minutes to get rid of any free chlorine which may be formed, the solution is diluted and the iron titrated with stannous chloride. The *Journal of the Chemical Society* says magnesium carbonate may be used instead of calcium carbonate.

Professor W. Crookes, F.R.S., Dr. W. Odling, F.R.S., and Dr. C. Meymott Tidy, reporting on the composition and quality of daily samples of the water supplied to London last month, state that "the exceptionally dry weather of July was not without effect on the character of the metropolitan water supply in respect to its degree of freedom from organic matter. Thus, the mean proportion of organic carbon present in the Thames derived water delivered during the past month was only ·121 part in 100,000 parts of the water, while the maximum quantity present in any one sample was only ·146 part, these quantities constituting respectively the smallest monthly average and maximum that have been recorded during the year."

In the Botanical Garden at Dijon there is a poplar of colossal dimensions—species not stated—to which Mr. Joly devotes a note in the *Journal de la Société Nationale d'Horticulture*. The height of this tree is 130ft. Its circumference near the earth is 46ft., and at 16ft. above the earth, 21ft. Its bulk is now 1590 cubic feet, but six years ago, before the fall of one of the largest branches, it was 1940. From some historic researches made by Dr. Lavelle, and a comparison with trees of the same species in the vicinity, it has been pretty well ascertained that this poplar is at least 500 years old. Unfortunately, it is now completely hollow up to the point whence the large branches spring. All the dead portions have been removed, and the interior has been filled in with beton.

A correspondent of *Nature* has written upon an old puzzle as follows:—"During eight centuries—say to the time of the Norman conquest—one's direct ancestors amount to a far greater number than would at first be contemplated. Taking three generations to a century, one has father and mother (2), grandparents (4), great-grandparents (8). At the end of the second century the number of ancestors springs to 64. Following the calculation you will find that at the end of eight centuries one is descended from no less than 16,000,000 ancestors. Intermarriage of course would reduce this estimate, and there is no doubt it must have largely prevailed. But the figures are so enormous that, in spite of all, I venture to suggest that the words 'All ye are brethren' are literally true."

Mr. C. C. Hine, editor of the *Monitor*, relates the following:—"The Institute of Technology, at Boston, long ago decided upon the danger of steam pipes passing through and in contact with wood. It was shown that the wood, by being constantly heated, assumes the condition, to a greater or less degree, of fine charcoal, a condition highly favourable to spontaneous combustion. Steam was generated in an ordinary boiler, and was conveyed therefrom in pipes which passed through a furnace, and thence into retorts for the purpose of distilling petroleum. Here the pipes formed extensive coils, and then passed out, terminating at a valve outside the building. To prevent the steam when blown off from disintegrating the mortar in an opposite wall, some boards were set up to receive the force of the discharge, and as often as the superheated steam was blown the boards were set on fire."

The following figures concerning the Great Eastern and the Ark are of interest. Somebody is comparing the size and cost of the Great Eastern and Noah's Ark. The cost of building and launching the Great Eastern was 3,650,000 dols., and this broke the original company. A new company was formed, which spent 600,000 dols. in fitting and furnishing her. Then this company failed, and a new company was organised, with a capital of 500,000 dols. At the close of 1880 this company sunk £86,715 upon the vessel, thus making her total cost 4,703,575 dols. Nothing ever built can stand comparison with the Great Eastern, excepting Noah's Ark, and even this vessel could not match her. The length of the Ark was 300 cubits, her breadth 50 cubits, and her height 30 cubits. The cubit of the Scriptures, according to Bishop Wilkins, was $21\frac{8.8}{10.0}$in., and computed into English measurement the Ark was 547ft. long, 91ft. beam, $54\frac{7}{10}$ft. depth, and 21,762 tons. The Great Eastern is 680ft. long, 83ft. beam, 56ft. depth, and 28,093 tons measurement. So Noah's Ark is quite over-shadowed by the Great Eastern.

In the United States only one entirely new furnace was blown in during the first six months of this year, namely, the Clifton Iron Company's Ironton furnace—charcoal—in Alabama. Several furnaces in other States have been rebuilt during the period in question, and are again counted in the active list. In January last there were 669 furnaces, which included many stacks which had not been in blast for a very long time, and others which could not be worked except during short periods of exceedingly high prices for pig iron. Nineteen bituminous and forty-nine charcoal furnaces, or seventy-eight in all, are out. Making due allowance for four furnaces rebuilt in the last six months, the net reduction in the total number of furnaces is seventy-four, which leaves 595 as the number of furnaces in the United States either in blast or likely to be blown in when trade shall warrant. To this number will shortly be added several furnaces which are now being rebuilt and others in course of erection which are entirely new. These comprise two coke furnaces in Pennsylvania, two coke furnaces in Tennessee, one charcoal furnace in Michigan, one charcoal furnace in Maine, and two charcoal furnaces in New York. Arrangements are also being made in Alabama for the erection of three coke furnaces and in Wisconsin for the erection of one charcoal furnace.

MISCELLANEA.

Lloyd's Committee, accompanied by their chief surveyors, Messrs. Martell and Parker, are making a tour of the shipbuilding and steel and iron-making centres. On Tuesday last they visited the Eston Works, and also those of the North-Eastern Steel Company.

L'Ergicito Argentino, the leading journal of the Argentine Republic, says that Captain Picasso, of the Argentine Army, has made an improvement in the mechanism of the service arm, the Remington, which reduces the loading and firing time by a quarter. Captain Picasso's improvement is in the shell extraction, he having adapted to the arm an extractor operating like the extractor of the Gras, the French service arm.

Another Alpine town will shortly be lighted by electricity, and following the example of Aosta, the municipality of Vazallo have recently decided to illuminate the town by electricity. The system to be adopted will be that of Cruto, and the streets will be lighted with seventy incandescent lamps. The current will be furnished by two dynamos driven by a turbine, as abundant water power is at hand in the torrent Sesia. Besides the public lamps, the dynamos will supply from 90 to 100 lamps in private houses.

A curious accident has occurred at West Hartlepool. Part of the quay wall of the Swainson Dock, which belongs to the North-Eastern Railway Company, suddenly gave way and fell into the dock, carrying with it shedding to the extent of a hundred feet in length. A steamer, called the Coral Queen, was discharging cargo at the time, abreast of the quay. She was not materially damaged, but was driven from her moorings, and some of her cargo fell into the water along with the *débris* of the wall. No one was injured, as the accident occurred early in the morning. Had it been two hours later, thirty or forty men would probably have been there, and would all have been thrown into the water.

The Secretary of the United States Navy having declared forfeited the contracts under which the Chicago, Atlanta, and Boston have been constructed by Mr. Roach, the vessels and their belongings have been placed in charge of the chiefs of the Bureau of Steam Engineering and the Bureau of Construction and Repair, and they will be completed at Mr. Roach's works by the Department in accordance with the provisions of the 11th section of the contract between the Department and Mr. Roach. It is understood that the inspecting officers of the two bureaus who are now employed on the vessels will be continued on that duty. Doubtless the work will now go on and the ships be made ready for sea at the earliest possible moment. There is nothing new in regard to the Dolphin.

In the United States chilled tools for metal cutting machines are growing in favour. One firm engaged in turning large forgings of steel in the manufacture of guns will only use chilled tools. In addition to the cost of good tool steel there is the waste connected with it. Good tool steel cannot be bought now at less than 9d. per lb., and, as a rule, only one half of it is consumed. There is always a piece at the last unused. Then, by the time that the tool steel has been heated and forged over and over again, its qualities are destroyed, and it reaches a period when it is hardly worth being used at all. Cast iron tools can be made at 1d. per lb., and when chill is worn off can be re-melted into new tools. The principal thing to keep in view in preparing chilled tools is to have a large chill so as to get the iron thoroughly hard.

Concerning glass-making, the *American Manufacturer* says: "In the manufacture of glass fifty years ago 28 lb. of potash and 26 lb. of wood ashes were used to every 100 lb. of sand. The first change from this was to burn the potash in an oven, and work it as a puddler does iron, in order to obtain better results; and this was used with lime in about the same proportions as potash and wood ashes above named. Soda ash was first used in New Jersey, but its introduction in Western factories was very rapid, and the mix was changed to 33 lb. soda ash and 26 lb. of lime to 100 lb. of sand. The proportions vary greatly with circumstances and the quality of the ingredients used. The following is a fair statement of the mix now mostly used: Soda ash, 40 lb.; lime, 30 lb.; sand, 100 lb. For salt cake, 33 lb.; soda ash, 10 lb.; lime, 33 lb.; pulverised charcoal, 2½ lb.; arsenic, 1½ lb.; sand, 100 lb. If the glass is muddy, the charcoal is reduced; if too green, charcoal is added and arsenic reduced."

Mr. William F. Zimmerman, of the Pittsburgh Testing Laboratory, has completed for the Detroit Dry Dock Company a test of the new steel plates which will enter into the construction of the new steamer they are building for the Detroit and Cleveland Steam Navigation Company. The average tensile strength of the plates is stated to be 60,000 lb. to the square inch. This soft steel is said to be of such remarkable elasticity that a piece of plate may be stretched one half longer than its usual size without parting. The Detroit Dry Dock Company recently made some experiments of its own with the soft steel used in the construction of the new steamer Mascotte at its yards in Wyandotte. They were made both with soft steel and the best quality of iron used in the construction of iron ships. Strips of cold steel plate $\frac{5}{16}$in. thick and $\frac{3}{4}$in. wide were twisted like an auger in a lathe, and even doubled, without cracking or causing a single abrasion of the metal's surface. Angle irons were flattened cold and bent in like manner. Another strip was bent repeatedly without causing it to break or even flaw. In the presence of the owners of the Mascotte, a large ball weighing 950 lb. was suspended at a height of 35ft. and allowed to drop on a $\frac{3}{16}$in. plate, bulging it about 20in. into the ground without breaking it. The ball was then dropped on the reverse side of the plate, and this repeated five times without breaking the plate. The same test was made with a $\frac{1}{4}$in. iron plate, and it was broken the first time. The *Scientific American* says:—"These tests are regarded as furnishing a conclusive demonstration of the comparative merits of soft steel and iron for resisting sudden shocks, and consequently of their respective merits as materials for the construction of modern ships."

The death is announced, at New York, in his fifty-third year, of Dr. R. H. Gilbert, the inventor of the elevated railroad system. The deceased was born at Guilford, Chenango county, New York, where his father, W. D. Gilbert, was one of the associate judges of Steuben county. Having a taste for medicine, he was apprenticed to a druggist in his native place; but his mind ran strongly upon mechanics, and he soon became tired of the apothecary's shop, and obtained a position in a large manufacturing establishment. Here he laid the foundation of that knowledge which in later years was to solve the problem of the present rapid transit system of new York. After serving in the war of the rebellion, Dr. Gilbert devoted all his time to the rapid transit problem. He first got up the pneumatic tube system, but abandoned it finally as impracticable. He then brought out his patent for an elevated railway, and obtained a charter for a road through Sixth-avenue and Second-avenue. The patent was for an arch thrown from one side of the street to the other, upon which a local train and a through train were to run on independent tracks, and which would afford a support also to the telegraph wires. It was some years before the work was begun, but Dr. Gilbert's unremitting efforts in the United States and Europe finally created confidence, and the required money was eventually obtained. The structure in Sixth-avenue was begun, rapidly carried forward, and on May 1st, 1878, the first car was run successfully from Trinity Church to Fifty-ninth-street in sixteen minutes. Dr. Gilbert was made chief inspecting engineer of the road, the name of the undertaking being changed from the Gilbert Elevated Road to the Metropolitan Transit Company. The company infringing his rights in the road, he brought an action to enforce his claims. The company replied by removing him, throwing him out of the directorship, but it finally compromised the matter by paying him 100,000 dols. in stock, which, however, has not paid any dividend since the last consolidation of the elevated railroads and the resulting lawsuits. Like many an inventor before him, Dr. Gilbert profited little from his labours, dying comparatively poor.

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.*

PUBLISHER'S NOTICE.

*** *With this week's number is issued as a Supplement, a Two-Page Engraving of the new Organ in Westminster Abbey. Every copy as issued by the Publisher contains this Supplement, and subscribers are requested to notify the fact should they not receive it.*

TO CORRESPONDENTS.

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

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

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

G. J. C.—*We are not aware of the existence of a list of foreign technical and industrial journals.*

D. C. (Houghton).—*Your letter only repeats what Dr. Lodge has put in a more precise form, and this being so, nothing would, we think, be gained by publishing it.*

J. J.—*Locomotive engines and tenders cost from* £1800 *to* £2500. *We have heard of a French locomotive which cost over* £4000. *This is the highest price ever given for one to our knowledge.*

Tubal Cain.—*Cast iron cannot be hardened, save by casting on a chill. You can use mixtures which will give you castings as hard as you can desire. Staffordshire white iron, for example, can scarcely be touched by a file.*

B. R. (Bunerton, New Zealand).—*The invention you describe is simply a modification of the turbine, a very old and well-known water motor. The fire-extinguishing device is probably new, but we do not think you will make any money out of it in this country.*

Voyager.—*It is impossible to give a more than general answer to your question. Everything depends on your introductions. In the colonies, as elsewhere, a man of your type has little or no chance of making money by his profession unless he has interest. As to which colony is best, that depends altogether on the interest you can bring to bear.*

CONCRETE MIXERS.

(To the Editor of The Engineer.)

Sir,—Will any reader kindly inform me who is the patentee or maker of Cary Latham's concrete mixing machine? J. M.
London, August 14th.

CAPSULE AND TINFOIL MACHINERY.

(To the Editor of The Engineer.)

Sir,—Can any of your correspondents kindly give me the address of the best makers of machinery for capsules and tinfoil? Laminoir.
August 13th.

SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

Half-yearly (including double numbers) .. .. .. £0 14*s.* 6*d.*
Yearly (including two double numbers) .. .. .. £1 9*s.* 0*d.*

If credit occur, an extra charge of two shillings and sixpence per annum will be made. The Engineer *is registered for transmission abroad.*

Cloth cases for binding The Engineer *Volume, price* 2*s.* 6*d. each.*

A complete set of The Engineer *can be had on application.*

Foreign Subscriptions for Thin Paper Copies will, until further notice, be received at the rates given below:—Foreign Subscribers paying in advance at the published rates will receive The Engineer *weekly and post-free. Subscriptions sent by Post-office order must be accompanied by letter of advice to the Publisher. Thick Paper Copies may be had, if preferred, at increased rates.*

Remittance by Post-office order. — Australia, Belgium, Brazil, British Columbia, British Guiana, Canada, Cape of Good Hope, Denmark, Egypt, France, Germany, Gibraltar, Italy, Malta, Natal, Netherlands, New Brunswick, Newfoundland, New South Wales, New Zealand, Portugal, Roumania, Switzerland, Tasmania, Turkey, United States, West Coast of Africa, West Indies, Cyprus, £1 16s. China, Japan, India, £2 0s. 6d.

Remittance by Bill in London. — Austria, Buenos Ayres and Algeria, Greece, Ionian Islands, Norway, Panama, Peru, Russia, Spain, Sweden, Chili £1 16s. Borneo, Ceylon, Java, and Singapore, £2 0s. 6d. Manilla, Mauritius, Sandwich Isles, £2 5s.

ADVERTISEMENTS.

*** *The charge for Advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office order in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

Advertisements cannot be Inserted unless Delivered before 6ix o'clock on Thursday Evening in each Week.

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

THE ENGINEER.

AUGUST 21, 1885.

THE DEPRESSION OF TRADE.

We have lying before us the Thirteenth Annual Report of the General Committee of Management of the Iron Trades Employers' Association. This report was presented at the annual meeting of the members, held in London on the 23rd of July. It is impossible to read it without apprehension. Its authors have nothing but disaster to record; and in no direction is light to be seen, or any indication that improvement in trade is likely to take place in the near future. The statements contained in the report are based on inquiries made in every direction by the Committee of Management. Over seven hundred returns have been obtained. They represent the engineering, ironfounding, boiler making, and iron shipbuilding trades to the extent of about 118,000 hands, and the general result shows "that trade is good only upon returns representing 2500 hands, moderate upon those covering 25,000 hands, and bad or very bad over the remaining area, covering an employment of 90,500 men." The picture of the condition of trade put before us is one of the most deplorable that can be imagined. After referring to the efforts of the masters to obtain work at almost any price, the report goes on:—"The reports from the workmen's side are equally cheerless, and in regard to the depressed condition of the labour market, they are all but unanimous; so that it is clearly shown that only by the extraordinary efforts of employers are the skilled hands and the labourers in the iron trades saved from a calamity which threatens to assume wider proportions, unless some improvement comes to the aid of masters and workmen before the next winter sets in. Whilst the capital of the employer is decreasing, the provident funds of the workmen are diminishing, in consequence of the extra strain upon their resources, which is being felt acutely by every trades union in the kingdom at this time." The report makes no mention of the causes which have induced this condition of affairs; possibly it was felt that to do this would be to travel beyond the field which the report is legitimately intended to cover. There is no reason, however, why the subject should not be fully discussed in our pages. It is one nearly concerning every reader of The Engineer. To attempt to handle it exhaustively would be to undertake a herculean task, but it is quite unnecessary to do anything of the kind. On certain prominent points it is possible to speak to the purpose within a comparatively limited space, and that is all that we intend to do.

In certain departments of trade it appears that there is no falling-off in the quantity exported or otherwise sold, but that there is a great reduction in price; in other departments both quantity and price have fallen. Now a fall in price can only be due to one cause, and that is competition. If one man has the supplying of an entire district with shoes he can charge anything he pleases for them, and he will soon find that there is a certain price which, if exceeded, the people will go without shoes rather than buy. If, on the other hand, he goes below it, he will sell more shoes but make less money. If, however, there are half-a-dozen shoemakers competing for custom, not one of the six can charge what he likes and yet command a market. At one time England was very much in the position of the isolated shoe maker. It seems a strange thing, yet is no less true, that half a century ago foreign nations, such as France, Prussia, Italy, Russia, and America, produced nothing for themselves save the necessaries and a few of the luxuries of life. No rails could be had out of England, no steam engines, no spinning machinery, no cotton goods, none of the better kinds of cloth, no locomotives, or marine engines, or steamships. The list might be extended indefinitely, we may include in it coal and iron. All that has been changed. About the year 1852 manufactures began to assume some prominence abroad. A little ball was set rolling, and it has gone on accumulating to itself until it has reached the proportions of a mighty avalanche, threatening to sweep English trade off the face of the earth. Under such circumstances of foreign competition as now exist it is simply impossible for prices to keep up. Nor is it reasonable that they should. Every effort has been made to cheapen production. We must not grumble if we have to sell cheaply. Twenty years ago three tons of coal were required to make a ton of iron. Twenty-five cwt. does the same work now. A ton of steel cost from £80 to £140. As good a material can be had for £20 a ton now. One result of all this cheapening is that the necessaries of life—if we except meat—clothes, houses, bread, fuel, tea, sugar, and such like, never were so cheap. In other words, the purchasing power of wages never was greater. A fitter earning 25s. a week now is really better off than he was a few years ago when earning 30s. Consequently a reduction in wages is in no sense or way as much to be deplored as it would be were the cost of necessaries high. It is not, indeed, in the matter of wages that the depression of trade presents itself in its worst aspect. It is that trade is so restricted that there cannot be any employment at any wages, however small, for hundreds and thousands of men, and the reason of this is, as far as England is concerned, that the markets of the world are gradually being closed against us, either by the operation of heavy tariffs, or because of competition. The Belgian cotton spinner will not come to England for a steam engine if he can get one better and cheaper at home. Whether he can or cannot, a visit to the Antwerp machinery gallery will decide very quickly. But not only is competition excluding us from foreign markets, it is also hitting certain trades very hard in the home market. Within the last few days the following facts have come to our own knowledge. One of the largest firms building marine engines on the north-east coast obtains all its steel castings from Germany. They are sent by rail from the works to Antwerp, thence by ship to the Tyne. The price paid for crossheads and such like is, we believe, £25 per ton delivered. The castings are perfect. English steel makers assert that it is quite impossible to deliver similar articles at less than £27 or £28 a ton. Surely this is a remarkable and suggestive fact. Again, it is stated that it is cheaper to take iron to Norway from England and build a ship there, than it is to work up the same iron in an English shipyard. Such facts as these tell their own tale.

It is quite evident that if the engineering, iron, and shipbuilding trades are to flourish, prices, low as they are, must go lower still, and at the same time the quality of the work must be kept up. It will be found on inquiry that the firms with a world-wide reputation are all more or less busy, although the prices they charge are high, relatively. Infinite harm has been done abroad by the attempt to palm off on the foreigner second-rate goods at a second-rate price. This is especially true of tools; and we are sorry to say that in south Europe, particularly Italy, English lathes, drills, and planing machines have come to be a byword and a reproach, and justly so. The attempt to undersell the foreign competitor has been made on a wrong basis altogether—the English tool maker trying to do what was an impossibility, when the rate of wages and hours of labour in the two countries are compared. In Belgium a fitter works twelve hours a day for about 3½d. an hour. It may be said that he is not as good a man as the English fitter. Perhaps this is true, perhaps it is not; but two Belgian fitters will certainly do a great deal more than one English fitter for the same wages. But it is not to reductions in wages alone that the English engine builder must look for assistance; he must organise his works so that every penny shall be saved that can be saved. We heard the other day of a contract in which the highest tender was a little over £30,000, the lowest a little over £20,000. The explanation of the enormous disparity lies in the fact that the lowest tender was based on a consummate knowledge of how the work could be turned out at the lowest cost; and the highest was based on no such information. The difference in this respect between the practice of different firms in the same trade would be almost incredible if we did not know how little communication takes place between the heads of rival firms. Again, a vigorous effort should be made to resist unfair imposts, such, for instance, as the unreasonable exactions of certain railway companies, rendered necessary in one sense, because the companies do not practice economy themselves. Another point for discussion is the rating of factories, which we are glad to see is being taken vigorously in hand by the Iron Trades Employers' Association. We cannot better conclude this article than with the following extract from the report which was supplied us with a text:—"In several of the chief centres of the mechanical engineering and shipbuilding trades, the members of our Association have, upon local grounds, joined with other users of machines to resist claims which are now being frequently put forward by overseers of the poor to rate machines which have hitherto been declared exempt from such liability. Pending the settlement of the question by the Legislature, our members in Leeds have, for mutual protection, made common cause with users of machines in industries distinct from the iron trades. In Newcastle-on-Tyne they have also joined in self-defence, and have subscribed the funds required for taking the case of the Tyne Boiler Works Company, on appeal from Quarter Sessions to the higher Courts, and, if necessary, to the House of Lords. In Manchester the firm of Sir Joseph Whitworth and Co. have been placed under a revaluation of their works by order of the overseers, and have been called upon to pay rates upon light machines and tools hitherto held to be clear of such liability, and our Manchester members have, as in Leeds and Newcastle-on-Tyne, made common cause with employers in other industries carried on in the township, and have agreed to raise the funds with which to try the case at Quarter Sessions, and, if required, to proceed as in the Newcastle case, till a final judgment has been given in the House of Lords. It is evident, therefore, that the question of rating machinery for the relief of the poor, and for other rating purposes, is growing in importance, and is claiming attention all over the manufacturing centres of the kingdom. The Committee about to be appointed to administer the affairs of this Association for the ensuing year will therefore, in this respect, have to carry forward the work from the point at which it will now be consigned to their hands, but with every reasonable prospect of success during the next session of Parliament."

ELECTRICITY, OIL, AND GAS.

The printed report of the Trinity House Committee which has lately completed at South Foreland, a protracted series of experiments on electricity, gas, and oil as light-house illuminants, has just made its appearance. Some of our readers doubtless availed themselves of the opportunity supplied by the recent visit to South Foreland of the Smeatonian Society of Engineers, of witnessing for themselves these interesting trials; and most of them have been aware, from the prominence which has been given in Parliament to this investigation—owing to an unfortunate controversy as to the constitution of the original committee—that a serious attempt was at length being made to determine, for at least lighthouse purposes, the relative merits of these three illuminants. Whether or not this result has been fully accomplished by the committee, it may, at any rate, be said of their report that it bears on its face abundant evidence of care and impartiality. Nor, however much regret may be entertained in some quarters that Professor Tyndall felt himself under the necessity of withdrawing from the investigation—for reasons which we have no wish at this time to recall—will there, we feel sure, be any desire to question the ability or the integrity of the scientific experts who were engaged to assist the Trinity House Committee, and whose names we append:—Mr. A. Vernon Harcourt, M.A., F.R.S., representing the Board of Trade; Professor W. Grylls Adams, M.A., F.R.S., for electricity; Mr. Harold Dixon, M.A., of Trinity College, Oxford, for photometry; Sir James N. Douglass, C.E., acting for the Trinity House; Mr. Thomas Stevenson, C.E., acting for the Scotch Light Commissioners; Dr. R. S. Ball, F.R.S., acting for the Irish Light Commissioners. We should add that Mr. E. Price Edwards, a Trinity House official of large experience in such matters, filled the post of secretary to the committee.

The main proximate cause of this investigation was, we believe, the desirability of putting to a complete and final test the claims of the multiform gas system invented by Mr. J. R. Wigham, of Dublin, and largely adopted by the Irish Light Commissioners. The supporters of this system contended that it was specially adapted for lighthouse purposes, for the following reasons, viz.:—(1) That the larger or the smaller intensities of the light could be instantaneously employed by merely turning on or off the gas; (2) that there was thus available a maximum power considerably in excess of that procurable from the largest concentric oil burners; and (3) that admitting the inferiority in intensity of the gas to the electric light, gas was, owing to the large dimensions of its flames, and to the preponderance in them of red rays, more penetrative in thick and foggy weather than the small violet-rayed electric light. To determine the questions thus presented, and kindred questions, the following arrangements were made:—On the site of the experiments—South Foreland—three strong wooden towers were erected,

in which were installed respectively the electric light, the gas light, and the oil light. The electric light was produced by three of De Meriten's magneto machines, each containing sixty permanent magnets of horseshoe form, eight laminated pieces to every magnet, the whole disposed in five rings of twelve magnets each, and associated with five discs revolving within them, each having twenty-four coils on its outer ring, the revolving portion being run at a speed of 600 revolutions per minute. The gas light was, as we have said, on the Wigham system, the burners, four in number, being each composed of 108 jets, compactly fitted within a circle of 11¼in. diameter. The lowest of the burners, which were superposed, was made in rings, removable, according to the intensity of light required to be invoked, by twenties in a ring, until the number of jets was reduced to twenty-eight, the others being constantly maintained at their normal power. The oil light was produced by three 6in. concentric lamps—also superposed—of the Trinity House "Douglass" old pattern, consuming paraffine, having a flashing point of 154 deg. Fah. Each light was surrounded by an optical apparatus arranged for producing both fixed and revolving effects, which were witnessed at sea as well as on shore, a photometric gallery having been erected near the permanent lighthouse premises, 380ft. by 8ft., for obtaining accurate measurements of the lights in competition. It has been explained that the oil-burners, as well as the gas-burners, were superposed, the former being arranged as a triform and the latter as a quadriform light. This is, we believe, the first occasion of an oil light for lighthouses being so shown, the highest number of burners hitherto superposed being two, as in the new Eddystone Lighthouse—fully described in a paper by Mr. W. T. Douglass, Institution of Civil Engineers, Part I., session 1883-4. Of this new departure Mr. Dixon thus writes in his report: "The problem of burning three large oil lamps within 6ft. of one another has been satisfactorily solved by Sir James Douglass."

We have only now to summarise, which we shall do very briefly, the conclusions at which the committee have arrived, viz.:—(1) The electric light is the most penetrative of the three luminaries in all conditions of the atmosphere, fog included. It, however, is more costly than either gas or oil, and its dazzling effect in clear weather renders it unsuitable for general adoption around the coast. (2) The gas and the oil lights are practically equal, but the latter system is considerably cheaper, and is simpler and more convenient than the former. The committee, therefore, recommend that "for the ordinary necessities of lighthouse illumination mineral oil is the most suitable and economical illuminant, and that for salient headlands, important landfalls, and places where a very powerful light is required, electricity offers the greatest advantages.'

LESSENED PRODUCTION OF LEAD.

At last it appears that there is a movement in the lead industry, and that prices, after being long depressed, have of late moved upwards and retain their firmness. It is not difficult to trace the cause of this; it is due to the reduction in the supply of lead, in consequence of the lower price, and now also in consequence of the outbreak of disease in Spain, which has long been one of the great sources of our lead supply. The former cause is one which may be prolonged, the latter can only be looked upon as temporary in its nature; but both together must for some time to come affect the lead market, though any serious increase in price would soon cause an enlargement of our home supply of lead. Meantime, however, we have that diminution in the production which has been showing itself gradually for some years. Last year the lead produced from British ores was 40,075 tons, or over 3000 tons less than the previous year; but the lead imported and the lead obtained from the foreign ores brought in showed a large increase. Spain gave us four-fifths of the total quantity of the lead we imported. Now that the great lead-producing country has had so serious an attack, the production of lead ore is being enormously lessened, though this does not show itself at first, for the stocks at the ports will be sent out. But they will not be so fully replenished, and thus there will be for some time to come, at least, a reduction of the large quantities of lead which Spain sends us. It is not to be expected that this will very long continue, but during its continuance there will be a relief which the British producers of lead will make the most of; and there is, on the other hand, a benefit for this ancient industry in the resumption of demand from China, which has long been one of the best of our customers for lead, and which is now beginning to buy more largely again after the partial suspension through its dispute with France and the closing of some of the ports. It may be fairly hoped, then, that there will be some improvement soon in this ancient and long-suffering trade, the dulness in which has grievously oppressed some of the lead mining dales for several years.

SMALL MERCIES.

For these the ironmasters, of all traders, are just now the most thankful. More than small mercies they do not look for from the railway companies, yet the railway companies are not incapable of being touched by the needs of the ironmaster, however difficult to move may still be the owners of mining royalties both in ironstone and in fuel. The small mercy which has just fallen to the lot of the Staffordshire ironmasters is a reduction of threepence per ton for the boating of pig iron from the railway stations to works situated on the canals of the London and North-Western, the Great Western, and the Midland Railway Companies. The charge will now be ninepence per ton for delivering by boat pig iron carried at station to station rates, and the rate will apply to iron invoiced from other companies' stations to the stations nearest to the works. Were the ironmasters in a less thankful mood they might acknowledge this concession on the part of the railway companies serving their district in the terms of the hackneyed couplet, which speaks of "dissembled love" and "kicking down stairs." The pig iron firms would seem to be fair game for the canal and the railway companies, who are fast becoming one and the same proprietory. The tonnage upon pig iron on the Birmingham Canal is 1½d., and the attempts of the ironmasters to bring it to 1d. have as yet been unsuccessful. They seek that it should be a penny because that is the tonnage upon certain iron hardwares, curtly denominated "pots and kettles." The ironmasters do not ask for pots and kettles to pay more, but they seek themselves to be placed upon equal terms, and they have substantial ground for their claim. A boatload of pig iron may be twenty-seven tons, but a boatload of pots and kettles is not usually more than five tons; consequently, a load of pig iron pays 27s. for freight, and a boatload of pots and kettles often not more than 5s.

LITERATURE.

The Royal Mail: its Curiosities and Romance. By James Wilson Hyde. Second edition. Blackwood and Sons, Edinburgh and London. 1885.

This is an octavo book of 391 pages, which we can confidently recommend to our readers. Mr. Hyde's position as Superintendent of the General Post-office, Edinburgh, has supplied him with many of the qualifications essential to the successful production of a work of this kind, and, in addition, he has brought to his task an agreeable style, and a keen perception of what is and is not dry reading. It is difficult, indeed, to say whether the book is more instructive or amusing, and we have not the least hesitation in saying that young people ought to read it for the sake of the information which it conveys. The fact that the volume has found favour with the public, as it deserves, is proved by the circumstance that the whole of the first edition was rapidly bought up. To the second edition some additions have been made to the chapters on "Mail Packets," "How Letters are Lost," "Singular Coincidences," and a fresh chapter on "Postmasters."

The sending and receiving of letters is so much a matter of course that few people realise the gigantic dimensions of the organisation known generally as the Post-office. The post is above and beyond all others a modern institution. Nothing at all resembling it existed in ancient times. Letters were transmitted from town to town at very early periods in history; but there was little or nothing in common with the old-world system and that now in vogue. That it should be possible to throw a missive into an iron box in the street, and, without taking further thought, know that that letter will be delivered to an address hundreds of miles distant in a few hours, never entered the brains of the wildest dreamers of historical times. Indeed the existing system is, to all intents and purposes, entirely novel. It can be hardly said to date back half a century. How it grew up and what were its beginnings our author narrates in very pleasant language; and it is worth notice that he never wearies his readers by prolixity of detail. Sam Weller said that the essence of success in letter writing was that the recipient of one should "wish for more." This is just the case with the book before us. We frequently find ourselves wishing that the author had told us a little more on any subject, but never wish that he had told us less.

We shall make no attempt to describe the book in detail. It is too moderate in price and too accessible to do this. We prefer to quote a few passages which will show what the author's method of dealing with his subject is. These we take at haphazard. Here is one which presents a curious picture. It is a circular issued by the London Post-office authorities on the 27th April, 1799:—"Several mail coaches being still missing that were obstructed by the snow since the 1st of February last. This is to desire you will immediately represent to me an account of all spare patent mail-coaches that are in the stage where you travel over, whether they are regular stationed mail-coaches or extra spare coaches, and the exact place where they are, either in barn, field, yard, or coach-house, and the condition they are in, and if they have seats, rugs, and windows complete." It appears from this that, after a lapse of nearly three months, the Post-office authorities had not recovered the missing coaches, and had, indeed, only just begun to hunt them up.

Contrast the picture presented by the following extract from the chapter on mail packets with the existing arrangements:—"It is curious to take a glimpse of the conditions under which the early packets sailed, when they were often in danger of having to fight or fly. The instructions to the captains were to run while they could, fight when they could no longer run, and to throw the mails overboard when fighting would no longer avail. In 1693, such a ship as then performed the service was described as one of 'eighty-five tons and fourteen guns, with powder, shot, and fire-arms, and all other munitions of war.' A poor captain whose ship, the Grace Dogger, was lying in Dublin Bay awaiting the tide, fell into the hands of the enemy, a French privateer having seized his ship, and stripped her of rigging, sails, spars, and yards, and of all the furniture 'wherewith she had been provided for the due accommodation of passengers, leaving not so much as a spoone or a naile-hooke to hang anything on.' The unfortunate ship, in its denuded state, was ransomed from its captors for fifty guineas. If we may judge from this case, the fighting of the packets does not seem always to have been satisfactory; and the Postmasters-General of the day, deeming discretion the better part of valour, set about building packets that should escape the enemy. They did build new vessels, but so low did they rest in the water that the Postmasters-General wrote of them thus: 'Wee doe find that in blowing weather they take in soe much water that the men are constantly wet all through, and can noe ways goe below to change themselves, being obliged to keep the hatches shut to save the vessel from sinking, which is such a discouragement of the sailors that it will be of the greatest difficulty to get any to endure such hardshipps in the winter weather.' These flying ships not proving a success, the Postmasters-General then determined to build 'boats of force to withstand the enemy,' adopting the bull-dog policy as the only course open in the circumstances. It may be interesting to recall how these packets were manned. In May, 1695, the crews of the packets between Harwich and Holland were placed on the following footing:—Master and Commander, £10 per mensem; mate, £3 10s.; surgeon, £3 10s.; boatswain, £3 5s.; midshipman, £1 15s.; carpenter, £3 5s.; boatswain's mate, £1 15s.; gunner's mate, £1 15s.; quartermaster, £1 15s.; captain's servant, £1; 11 able seamen at £1 10s. each, £16 10s.; agent's instrument, £2; in all, £50 per mensem. These wages may not have been considered too liberal considering the risks the men ran; and as an encouragement to greater valour in dealing with the enemy, and as an additional means of recompense, the crew were allowed to take prizes if they fell in their way. They also 'received pensions for wounds, according to a code drawn up with a nice discrimination of the relative value of different parts of the body, and with a most amusing profusion of the technical terms of anatomy. Thus, after a fierce engagement which took place in February, 1705, we find that Edward James had a donation of £5 because a musket-shot had grazed on the tibia of his left leg; that Gabriel Treludra had £12 because a shot had divided his frontal muscles and fractured his skull; that Thomas Williams had the same sum because a Granada shell had stuck fast in his left foot; that John Cook, who received a shot in the hinder part of his head whereby a large division of the scalp was made, had a donation of £6 13s. 4d. for present relief, and a yearly pension of the same amount; and that Benjamin Lillycrop, who lost the forefinger of his left hand, had £2 for present relief, and a yearly pension of the same amount.' Some other classes of wounds were assessed for pensions as follows: 'Each arm or leg amputated above the elbow or knee is £8 per annum; below the knee is 20 nobles. Loss of the sight of one eye is £4; of the pupil of the eye, £5; of the sight of both eyes, £12; of the pupils of both eyes, £14; and according to these rules we consider also how much the hurts affect the body, and make the allowances accordingly.'"

In 1829 voyages out and home to the places we are about to name occupied the accompanying number of days:—Jamaica, 112; America, 105; Leeward Islands, 91; Malta, 98; Brazil, 140; Lisbon, 28.

For those who love statistical illustrations, as we may call them, what can be better than this:—"The quantity of paper used in this annual interchange of thought through the intermediary of the British Post-office may, perhaps, be measured by the following facts: Supposing each letter to contain a single sheet of ordinary-sized note-paper, the post-cards taken at the size of inland post-cards, book-packets as containing on an average fifty leaves of novel-paper, and newspapers as being composed of three single leaves 18in. by 24in., the total area of paper used would be nearly 630 millions of square yards. This would be sufficient to pave a way hence to the moon of a yard and a-half in breadth; or it would give to that orb a girdle round its body 53 yards in width; or, again, it would encircle our own globe by a band 14 yards in width. Another way to look at the magnitude of the Post-office work is as follows: Suppose that letters, book-packets, newspapers, and post-cards are taken at their several ascertained averages as to weight, the total amount of the mails for a year passing through the British Post office, exclusive of the weight of canvas bags and small stores of various kinds, would exceed 42,000 tons, which would be sufficient to provide full freight for a fleet of twenty-one ships carrying 2000 tons of cargo each. What a burthen of sorrows, joys, scandals, midnight studies, patient labours, business energy, and everything good or bad which proceeds from the human heart and brain, does not this represent! yet, after all, what are the figures above given when put in the balance with the facts of nature? The whole paper, according to the foregoing calculations, although it would gird our earth with a band 14 yards wide, could only be made to extend hence to the sun by being attenuated to the dimensions of a tape of slightly over one-eighth of an inch in width!"

The most amusing part of the book is that which describes what may be termed the internal life of the Post-office. Here is an apology from one of the officials, which is most delicious reading: "The Postmistress of ——, Cambridge, is very sorry that she has not sent in her accounts before this. She will be sure to do so to-morrow. The delay is on account of her having three little motherless grandchildren staying with her for a few days." Again, candidates for appointments are asked certain medical questions, in order to secure healthy individuals. Dr. Lewis, medical officer of the Post-office, London, for many years, records the following examples of answers received to his questions:—"'Father had sunstroke, and I caught it of him.' 'My little brother died of some funny name.' 'A great white cat drawed my sister's breath, and she died of it.' A parent died of 'apperplexity;' another died of 'parasles.' One caught 'Tiber fever in the Hackney-road;' another had had 'goarnders;' a third 'burralger in the head.' Some of the other complaints were described as 'rummitanic pains,' 'carracatic fever,' 'indigestion of the lungs,' 'toncertina in the throat,' 'pistoles on the back.' One candidate stated that 'his sister was consumpted, now she's quite well again;' while the sister of another was stated to have 'died of compulsion.'"

To quote further would be unfair to the author of this delightful book. We cannot resist the temptation, however, to give a few strange addresses:—

The address,

23 Adne Edle Street, London,

proved to be intended for

2 Threadneedle Street, London.

In another case,

No. 52 Oldham & Bury, London,

was written for

No. 52 Aldermanbury, London.

On another occasion the following address appeared on a letter:—

too dad Thomas
hat the ole oke
Otchut
10 Bary. Pade.
Sur plees to let ole feather have this sefe;

the address being intended for

The Old Oak Orchard,
Tenbury.

A further odd address was as follows, written, it is presumed, by a German:—

Tis is fur old Mr Willy wot brinds de Baber in Lang Kaster ware ti gal is. gist rede him assume as it cums to ti Pushtufous;

the English of the address being—

This is for old Mr. Willy what prints the paper in Lancaster where the jail is. Just read him as soon as it comes to the Post-office.

THE ANTWERP INTERNATIONAL EXHIBITION.

No. II.

This latest addition to the constantly increasing list of "World's Fairs" may in some way be regarded as an offshoot of its predecessor held at Amsterdam in 1883, where the possibility of organising an International Exhibition by private capital, without State subventions, was satisfactorily demonstrated. A similar arrangement has been adopted in the present instance, the buildings and grounds being laid out by a syndicate of capitalists, the cost being met by rents of exhibition space, admission fees, and other sources of revenue, among which a lottery, with prizes from £4000 downwards, which may be won by speculating to the extent of a franc, figures prominently. The administrative and international relations are placed under the Ministry of Public Works, the Commission being presided over by Comte H. d'Oultremont, as Commissary-General of the Government. Although not of the imposing dimensions of the gigantic Exhibitions of Paris and Philadelphia, the buildings are of considerable magnitude, and the skilful arrangement adopted by the architect, M. Bordiau, have endowed them with a monumental character such as is not always realised in temporary structures. The site, apart from certain irregularity of shape, is an exceedingly good one, being at the extreme south end of the town, in what is known as New Antwerp, where the ground formerly occupied by the old southern citadel has been cleared and laid out in new streets, which are to a great extent still free from buildings; so that it has been possible to form an area of about 50 acres, with a principal frontage of about half a mile, facing the end of the line of avenues that have replaced the old line of interior fortifications, and on the other side resting on the basin allotted to canal traffic on the southern quays. Rather more than half the enclosed space is laid out as a park, with numerous separate buildings erected for special exhibitors—for those of eatables and drinkables, in the shape of restaurants, and more particularly *pavillons de dégustation*, &c., which, as the Inventions Exhibition and its predecessors have demonstrated, are among the more important aids to the proper appreciation of scientific industry. The Exhibition buildings proper form two principal blocks, as will have been gathered from the plan we published last week, of which the large one is appropriated to products, and the second to machinery in motion. The former, or Gallerie Internationale, is of irregular shape, bent approximately to a rectangular form; the largest dimension running nearly north and south is about 1700ft., while the maximum breadth is a little over 600ft. The machinery hall, a regular rectangular building, about 620ft. by 490ft., lies to the east of the main building, but separated from it as stated in our last impression. In the same way the north end of the grounds is connected by a bridge with the innermost of the canal basins, which is enclosed to form the Exhibition Maritime, where boats and shipping may be shown afloat. This part of the Exhibition has not as yet found much favour, and has only had a few temporary occupants in the shape of steam and sailing yachts belonging to visitors who have only stopped for a few days at a time. The total exhibition space is given at 72,660 square metres—about 780,000 square feet, or nearly eighteen acres—which is distributed among the different nations taking part in the Exhibition in the following proportion :—

	Sq. metres.		Sq. metres.
Belgium	25,000	Luxemburg	600
France...	20,000	Spain	500
Germany	6,000	Switzerland	500
Italy	4,000	Brazil	200
United Kingdom	3,600	San Salvador... ...	150
Austria	3,000	Hayti	150
United States ...	2,000	Turkey	150
Russia...	2,000	Portugal...	100
Netherlands ...	2,000	Monaca	100
Sweden & Norway	1,300	Servia	60
Canada	1,200	Paraguay	50

Of the total space more than one-half is occupied by Belgian and French exhibitors in nearly equal proportions; while the United Kingdom, apart from Canada, takes only the fifth place, with only about 5 per cent. of the area. These figures are sufficient to indicate that the Exhibition is, in its principal features, mainly one of Belgian and French products. As will be seen from the plan, the two nations occupy about equal spaces in the main building, but in the machinery hall considerably more than half the area is filled by Belgian exhibitors.

The design of the buildings is of the simplest character. The main galleries are divided into seven parallel aisles by pillars built up of ⌐ and angle irons of the smallest possible section, and which are for the most part lost in the decorations covering them. No uniform system of ornamentation has been followed, the section allotted to each country having been handed over as a whole to its National Commission, which has decorated it in accordance with the national tastes and peculiarities. This, although detracting from the monumental character of the building as a whole, adds considerably to the interest of the different parts. Among the more remarkable of these decorations are those of the French section of the main transept, or Gallerie Leopold II.; the Dutch Gallery, with its walls decorated in panels, imitating the blue and white landscape tile work of Delft; and the Russian Court, in brightly coloured woodwork, with round arches and fantastic columns, realising the Byzantine enamel work of the Moscow goldsmiths. The system of national decoration, though general, is not universally followed, prominent among the exceptions being the section occupied by the United Kingdom, where there is abundant opportunity for studying the construction of the building, the national decorative effect being concentrated in the provision of three printed red ensigns of the pocket handkerchief type, which are suspended by the corners from the centre of the roof. This absence of ornamental accessories is due to the circumstance that the Government 'of the United Kingdom, although taking part officially like other nations, has, unlike them, made no contribution to the expense of fitting up their part of the building, and the exhibitors have for the most part been content with setting out their wares in lines, like stalls in a market, with a complete indifference to style or effect. This is much to be regretted, as in a purely commercial centre like Antwerp an inefficient display is likely to do more harm to a country than complete abstention. Considerable want of judgment is also apparent in the prominence assigned to insignificant objects, such as mechanical toys, portable seats, and slag pottery, the latter claiming to be the latest marvel of science, occupies several stalls in the centre of the British Court, to the detriment of other and more valuable exhibits, which might have been more worthily placed. In the main avenue the Indian and Oriental objects make a more worthy display, and among these the Peninsular and Oriental Company's collection of models and drawings of the principal ships of its fleet, with a short historical account of the progress of the company, is particularly noticeable. In the machinery hall the case is different, British machine makers being fairly represented, though only on a limited scale.

Taken as a whole, the Exhibition is essentially one of products rather than of processes, inventions, or raw materials, the most prominent portions being occupied by ornamental objects of Belgian and French origin, such as the bronzes of Thiebaut and Barbedienne, of Paris, enamels and metal work of Christofle and others, tapestry from Aubusson, and the branch of the same manufactory at Malines, the latter being represented by three scenes from ancient Flemish history, belonging to the Belgian Senate. The central position in the main building is marked by a clever trophy composed of boxes, bales, barrels, and packages of other descriptions representing the raw materials received and distributed by the port of Antwerp. These are arranged in the form of four columns supporting a dome and central pinnacle very nearly to the roof of the great transept, forming an effective monument, whose serenity is enhanced by the brilliancy of its surroundings, the stall immediately adjacent, that of Mr. L. Coeterman, of Antwerp, being devoted to diamonds and diamond cutting. This includes a very remarkable series of diamond crystals from Kimberley, South Africa, with specimens of the matrix, or "blue earth," and views of the mines and wire rope hauling arrangements. This may be considered as the most prominent mineral exhibit, although it might more properly have appeared in the British section.

In mineral products there is little that is new or remarkable, the most prominent displays being those of the Belgian and Westphalian coalfields, the former being in the main building, and the latter in the machinery hall. The Belgian coal exhibit, placed about the centre of the northern limit of the main building, is due to the united efforts of the Société Generale pour favorites l'Industrie nationale, of Brussels, the Union of Mines and Works in the province of Liège, and several individual colliery companies, including those of Mariemont and Bascoup, and Strepy-Bracquenie, the different objects exhibited being grouped in a series of cases radiating from a central pillar of coal crowned by a statue of a collier in working costume. Below the floor of the gallery a full-sized representation of the method of working coal has been arranged by the Société Generale. This includes a "traverse banc," or stone drift, the "bouveau" of Hainault, or "bacnure" of Liège, a "costrene," or main heading, and a working face on the coal, the whole being in communication with the surface by a section of a circular bricked pit, with guides, and cage, with flat aloe fibre drawing rope. This very popular object has been constructed by two engineers, M. Soupart, of Mons, and M. G. Desenfaus, of Charleroi.

The general impression conveyed by the examination of the different objects in this collection is that coal mining in Belgium is carried on under special and increasing difficulty, a powerful cause being the disturbed character of the measures and the small thickness of the seams, although the number of the latter is considerable. The folding and corrugating of the strata is very considerable over a great part of the basin, and along its southern edge the stratas are completely masked so that the carboniferous limestone and Devonian strata appear at the surface above the coal measures. This necessitates the execution of much dead work, in the shape of stone drifts, as a preliminary to working the coal; and the coal as a rule being much shattered, gives rise to an inordinate proportion of slack; so that the product of the mine requires elaborate sizing and cleaning before it is saleable to advantage. These peculiarities are well illustrated by the exhibit of the United Companies of Mariemont and Bascoup, whose mines, situated in the eastern part of the Hainault basin, are represented by a surface model and numerous drawings. The area of their concessions is 3890 hectares—about twelve square miles—containing sixteen or seventeen workable seams varying from 14in. to 65in. in thickness, which are mined at ten different points by single and grouped pits, at depths from 350 to 670 yards, producing from 3500 to 4000 tons of coal per day. The different pits are connected by an endless chain system of traction, with a central screening and washing establishment, where the large coal is separated from the small, and the latter is purified from shale and dust. The sizes established are the following :—Large, 160 mm.; Gailletteries, 50—160 mm.; Gaillettins, 30—50 mm.; Tetes de Monieaux (sparrow heads), 11—30 mm. These are all clean coal, with 3½ to 5½ per cent. of ash, and separated by the Briarte riddle with mechanical delivery to prevent further breakage. The lower sizes made by perforated plate screens are grains of 25—16 mm., 16—11 mm., and 11—5 mm., and dust of 5—0 mm. These are all mixed with dirt, and give from 10 to 13 per cent. of ash, which is reduced from 4½ to 5½ per cent. by washing. The slimes produced in the depositing basins of the washing machines are burnt under the colliery boilers, the other products being sold. The mixed dust and grains, when worked, are largely used as locomotive fuel, which is rendered sufficiently coherent on the grate by mixing the dry slack with a certain proportion of that from coking coal. The latter quality is, therefore, of considerable importance, and special methods are adopted by the State Railway Department at Malines for determining the binding property of the fuel when heated as well as its evaporative value. This is done by coking the slack under examination with sand mixed in increasing proportion until the limit of cohesion in the coke is reached. The traction arrangements of the Mariemont Company are of a very elaborate character, a total length of nearly six miles of endless chain-ways being in use at the surface, and about an equal length underground. The chains used are of steel, single linked, varying from 16 to 25 mm. in thickness, which take hold of the top of the tub and receive a slow motion from a steam engine. The drum wheels, originally of cast iron, with a rim shaped to the chain links, have been replaced by others with forked claws of cast steel, which are screwed to the rim and adjustable for wear. The speed is so regulated as to give time for the unloading and return of each tub before the arrival of the next. The average speed is about 14ft. per second, and the distance between the tubs 65ft. The surface work is almost entirely done by women. A similar system of traction is in use at Seraing, where two or three women at the foot of an incline receive and discharge all the coal used by the forges and mill boilers. The Belgian coal-field is as well-known, covered in part with deposits of secondary and tertiary age, the so-called *morts-terrains*, which are, however, matter irregularly distributed. In the western part of the Mons basin, on the water parting between the Scheldt and Meuse rivers, the hydrographical conditions are such that the tertiary strata capping the coal measures, about 160ft. thick, contain beds of quicksand, which have proved very serious obstacles to the winning of new pits. These have in many cases been overcome by the use of the Kind-Chaudron method of boring through the water-bearing beds to the solid ground, and tubbing out the water with solid cast iron cylinders. Examples of such tubbings are exhibited by the Strépy-Bracquenie Coal and Iron Company, near Mons. There are three rings intended for lining a pit of 4 metres diameter, about 3in. thick in the flanges, and weighing 12, 16¾, and 18 tons respectively, which are exhibited on the ground near the section of the Antwerp quay wall. The usual practice has been to cast these tubbing rings near to the pit, but the Strépy Company has established a large foundry, principally for this class of work. It is rather difficult to see how such clumsy objects could be sent to any distance except where water carriage is available, which, however, is the case in Belgium, where, in addition to the very complete system of railways, efforts are being continually made to improve the internal navigation. For instance, the principal canal tunnels are now being enlarged to carry boats of 250 tons burden. The Strépy Company also shows a machine for shaping the ends of pit timbers. This is a rotary drum carrying a series of plane irons inclined at 90 deg. to each other, which cut off the end of the stick to a V edge. This machine, which is said to do the work of ten skilled men, is in the main building. A new pit at Maurage, lately bored by the Kind-Chaudron process, is now being lined with tubbing of this character to a depth of 283 yards from the surface.

The system of securing pit shafts with iron instead of timber or masonry is coming into favour in Belgium. Examples of its application to both round and elliptical pits are shown in the grounds. The system adopted is generally similar to that in use at Saarbrücken, namely, rings of [iron about 10in. deep put together in four segments by fish-plates, and supported by struts of similar shape but lighter section. The internal divisions are made either in wood or iron, but preferably the latter, the guides for the cages being usually ordinary flat-bottomed rails.

The large boring machine, or "bosseyeuse," of Dubois and François, which will be remembered as shown in the Belgian section of the Health Exhibition, is a prominent object in the main building. It is sent by the Société de Marihaye, of Flémalle-Grande, near Liège, and is arranged as used in driving galleries, the position of the different holes and cuts being shown in a full-sized section. The holes are bored about 3in. in diameter, and then broken down by wedging, a heavy sledge or mallet being substituted for the boring head. The machine is now so successfully used that the whole of stone drifts and other levels required for laying out the coal previously to working, are performed by it to the entire exclusion of gunpowder, the production of the company's different mines being about 400,000 tons annually.

The increase in the depth of Belgian collieries in late years is very marked, pits of 600 to 700 yards being common, while several are over 800. Prominent among these are the six pits of the colliery Sacré Madame, near Charleroi, whose depths are 756, 825, 800, 800, 770, and 770 metres respectively. These are all fitted with powerful drawing engines, the last three being intended to draw 600 tons in ten hours from a depth of 1000 metres. The general type of construction of these is horizontal, with Corliss framing and Sulzer valve gear with hydraulic governors, which allow a large range of expansion, the cut-off being variable between the whole length and one-ninth of the stroke. The steam pistons are 1 metre diameter and 1·80 metres stroke, and draw a net load of 54 cwt. of coal from 800 metres deep in 65 seconds. Flat ropes of aloe or manilla fibre of tapered section, weighing 8·25 kilogs. per metre, are generally used, though they are now being replaced by others of steel wire, weighing 7 kilogs. per metre. The preference for flat ropes of vegetable fibre over those of cylindrical section and steel is still marked in Belgium, and is well represented by the exhibit of M. Vertongen-Goens, of Termonde, who sends a 14-metre length of a flat rope 940 mm. broad and 20 mm. thick. This is, however, not intended for winding, but as a travelling table for use in hand-picking shale from coal. The most notable departure from the ordinary Belgian practice is furnished by the great winding engine at Seraing, with a spiral drum of 33ft. maximum diameter, which draws, by tapered steel ropes, from a depth of 525 metres in 45 seconds. The drawings of this magnificent engine will be found in the Cockerill collection on the left-hand wall of the staircase leading to the Machinery Hall. Probably the deepest pit at present is that of Marchienne, where the first coal seam was found at 726 metres, and by subsequent sinking three others at 802, 825, and 866 metres—947 yards—respectively.

Coal-mining in Belgium, as in other countries, cannot at the present time be classed among profitable industries. According to two accounts furnished, one by the Société Générale and the other by the Province of Liège Union, which together represent 8½ millions out of the 18 millions produced by the whole country, the selling prices were in 1883, 10·02f. and 10·19f. per ton, while at present they are said to be lower than at any time since 1853. The Société Générale produced 4½ million tons, employing 28,408 hands—men, women, and boys above twelve years of age—of whom 5178 were actively employed in getting coal, or rather less than one-fifth, the average wages paid being 3·10f. per day. A similar disproportion is observed between the engine power actually drawing coal and that employed in accessory operations, which was distributed as follows:—

	H.P.
Winding	17,545
Pumping	8,559
Ventilation	5,424
Handling and cleaning coal	923
Other operations	4,431
	36,882

The number of horses employed above and below ground is 1367. In the Liège basin, owing to the number of old shallow workings, the disproportion between drawing and pumping power is still greater, the seventy-seven collieries at work employing—

	Engines.	H.P.
For winding	108	10,486
For pumping	74	12,102
For ventilation	81	1,754
For other operations	220	2,254
		26,596

The wages of the 24,309 hands employed averaged 3·39f. per day. The cost of coal at Liège is given at 10·19f. per ton, of which 5·90f. goes for wages and 4f. in other charges, leaving a profit of 0·29f., or something less than 3d. per ton. The Société Générale gives the cost of coal per ton apart from financial charges as 8·64f. per ton, made up in the following proportions per cent.:—

	Per cent.
Wages and subventions to miners	60·45
Stores and materials	19·70
Colliery consumption of coal	5·88
Other charges	13·97
	100·00

Taking the figures for the year 1884, the wages paid are to the net profits in the proportion of 94 to 6, which latter figure corresponds to a return of 1·57 per cent. on the capital sunk in the business. These figures are sufficient to show that the complaint of trade depression is not confined to these islands, but is quite as severe in continental countries.

The second great colliery collection—that of the Rhenish Westphalian coal mines—in the Machinery Hall, has been brought together by the coal trade societies of Essen and Bochum, for the purpose of illustrating the structure and working conditions of the largest of the European coal-fields, and which produced in 1884 28,259,184 tons of coal, 99,875 hands being employed. The collection, apart from specimens of coal, consists mainly of drawings and models. The former, which are mostly contained in enclosed dark galleries lighted by electric lights, include numerous cross sections of the basin and details of methods of working machinery, &c. The order of succession in the coal seam is very similar to that observed in Belgium, the highest seams giving a long flame coal, which is succeeded in depth by gas, coking, and dry steam coals. Where best developed the thickness of the measures is very great, the lowest known seam being about 7000ft. below the surface in the bottom of the basin. The models include a winding engine and pit frame at Shamrock Colliery, a Kley compound beam engine for pumping, with combined fly-wheel and cataract, at Helene-Nachligall; Karlik's pendulous rotary screen, used in sizing coal at Gute-Hofforungs Hütte; and the pit frame and surface buildings of the Zollverein No. 3 pit, near Essen. This pit is laid out for a very large production, having guides for four cages and two winding engines, drawing simultaneously. The iron pit frame and corrugated iron buildings are in strong contrast with the castellated brick buildings of the older pits adjacent. A useful novelty in the shape of zinc air pipes, strengthened by corrugation like Fox's boiler flues, is also worthy of notice. These are coming largely into use in Westphalia.

Awards at the Inventions Exhibition.—The "anti-collide," for which, according to the official report, a bronze medal was awarded to Mr. F. Bapty, Leeds, should have been described as Messrs. Fox and Fenby's patent. Mr. H. B. Fenby is the inventor of the apparatus, which is an automatic fog-horn blower for preventing collisions at sea.

Fatal Accident at Chatham.—An extraordinary and fatal accident occurred at Chatham not long since. The superintendent of the Military Balloon Constructive Branch of the School of Military Engineering, was instructing some subordinates in the charging of steel tubes with compressed hydrogen gas to be used in inflating balloons on field service. The tubes consist of steel cylinders, 2ft. long and 4in. in diameter. He had taken one in his hands and applied the vacuum pump, when, from some unexplained reason, it exploded with terrific force, striking the superintendent in the abdomen, and killing him on the spot. Major Templar, chief of the balloon department, was immediately summoned and doctors were fetched, but nothing could be done for the unfortunate man. An inquiry will be held. This is the first accident of the kind.

Engineering Education in New South Wales.—The facilities afforded at the Sydney University to those acquiring a knowledge of engineering are extremely liberal, but it is found that the course of lectures is more attended by non-matriculants than by undergraduates. To meet the convenience of non-matriculants the lectures on civil engineering, applied mechanics, and architecture, are delivered at 4·30 p.m. The New South Wales Government has consented to allow the graduates in engineering to finish their practical training in the Government workshops and on the railways, and has given assurance of preference to B.E. graduates for appointments in the service. A testing machine has been procured from England. It is designed to test the strength and elasticity of materials used in engineering and building constructions, and it is expected to be of much value in testing colonial materials, including the many varieties of timber.

ON THE STANDARD OF ELECTRO-MOTIVE FORCE.

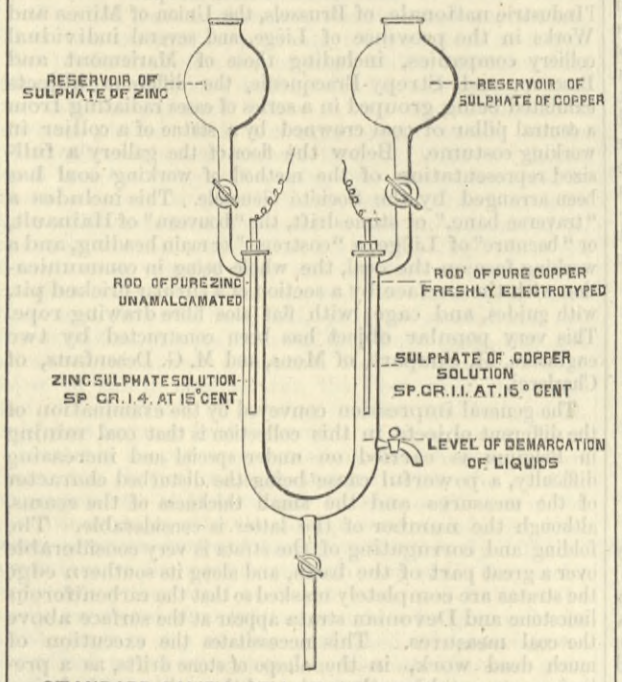
The Edison and Swan United Electric Light Company has now accumulated evidence to a very large extent which indicates the very great degree to which the average life of incandescence lamps depends upon the electro-motive force or pressure at which they are used, and it has just published the following information on the subject:—

If a lamp is made to burn at 100 volts, its life is very considerably lengthened by being used at 97 and 98, and very considerably shortened by being used at 103 or 104. It is therefore of the greatest importance that we, as manufacturers of incandescence lamps, should secure an absolute identity of standard, in order that divergency of reckoning may not exist between ourselves and our customers, owing to errors and discrepancies between the scale readings of the various voltmeters in the market. It is not sufficient to be within 2 or 3 per cent. The desirable thing to be attained is that voltmeters all over the United Kingdom should agree to within ¼ per cent., and our customers would then be certain that the pressure under which they were burning our lamp is the same pressure as that which we marked on it as its proper or normal volts. There is another cause of discrepancy in existence other than errors in existing voltmeters, and that is the ambiguity about the standard itself.

The British Association Committee on electrical standards, appointed in 1862, defined the standard of resistance, electro-motive force, and current, and constructed many standards of resistance. These principal standards have been compared in 1865 by Hockin, in 1874 by Chrystal, and in 1879 by Fleming, and found to differ slightly. Very careful experiments in 1879 and 1880 established the most probable mean value, and Lord Rayleigh's classical researches in 1880-1883 have established the fact that this mean British Association unit is only ·9867 of the true ohm, or 1½ per cent. too low. Accordingly, all measurements made in old B.A. units in old resistance-boxes and measurements of E.M.F. have to be multiplied by ·9867 to convert to true ohms and volts. The Paris Congress of Electricians defined in 1882 another unit—the legal ohm and legal volt. The legal ohm is the resistance of a column 106 centimetres long of pure mercury at 0 deg. C., having a cross section of 1 square millimetre, and the legal volt is the E.M.F., which will maintain an ampère of current through this resistance. According to Lord Rayleigh, the true ohm is 106·24 centimetres, and hence the legal ohm is $\frac{1}{1\cdot0624}$ smaller than the true ohm. The directors therefore consider it advisable to make known to their customers the standard of electro-motive force which is used in their lamp factory in the standardisation and testing of lamps, in order that users of their lamps may be in a position to check their voltmeters and to arrive at an identity of measure. We now, therefore, beg to advise all our customers that the standards and standardising instruments now in use at our lamp factory are as follows:—

1. Our standard of electro-motive force is the legal volt as defined by the Paris Congress of 1882. Our standard of resistance is the legal ohm.

2. Our actual standard of electro-motive force is a Daniell's cell, employing metals and solutions selected by Sir William Thomson, and set up in the following manner in the form of a cell devised



STANDARD DANIELL CELL—E.M.F. 1·072 legal volts at 15 °/₀

by Dr. Fleming. The solutions used are a pure solution of zinc sulphate of specific gravity 1·4 at 15 deg. C., and a solution of pure copper sulphate of specific gravity 1·1 at 15 deg. C. The metals used are pure unamalgamated zinc and copper freshly electrotyped. The exactness of the electro-motive force depends greatly upon the solutions being of the exact specific gravity above mentioned, and upon the copper rod being freshly electrotyped with a thin pure layer of unoxidised copper the instant before using. The electro-motive force of this cell is 1·072 volts true at 15 deg. C., and may be taken as very approximately to represent the same value in legal volts.

3. The instruments used for comparison of this standard with the working pressures are Sir William Thompson's graded galvanometers. The potential galvanometer must be set up in the place it is going to be used, and the value of its scale readings determined by this standard cell, and from time to time checked as the controlling magnet alters its value slightly with time. The company will shortly be prepared to furnish standards of resistance, or legal ohms, and to issue standard cells of the above pattern for use in calibrating graded galvanometers, and full instructions for setting up the cell and working it will be sent with it.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—George Quick, chief engineer, additional, to the Valiant; Stephen B. Williams, chief engineer, additional, to the Defence; Charles J. Cock, engineer, to the Ariel (tender); Henry G. Burr, engineer, to the Elk; Frederick J. Kingston, engineer, to the Firm (tender), for temporary service; and Thomas Agnew, engineer, to the Alecto.

A Safety Gauge Construction.—Last month experiments were made on the Danish State Railways at Aarhus with a safety gauge constructed by Hen. Lysholm, of Skanderborg, a railway engineer, whereby accidents are to be prevented if a train crosses a point which may have been omitted to be opened, or where the same refuses to act. The invention, not being as yet patented, is a secret, but the experiments were very satisfactory, a train consisting of an engine and four carriages entering a closed crossing and the broad gauge without leaving the metals. The experiments were witnessed by the leading engineers of the Danish railways.

LETTERS TO THE EDITOR.

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

THE EFFICIENCY OF FANS.

Sir,—I hardly know how to reply to Mr. R. H. Graham; he comes up a second time with such very curious statements. He takes no notice of my having told him that if he had troubled to look again at my letter from which he supposed he was quoting correctly "from memory," he would have found that he misquoted me on all the points he raised; but he now says "I admit that I set out from the equation for compression instead of from the correct equation of steady motion." Where does he find this strange "admission?" I certainly use the formula for compression work in the complete equation I gave, but I proceeded to show that that item in the equation was negligeable in practice and to simplify the equation by its omission. This is not in my letter replying to Mr. Graham, but in the original paper. Mr. Graham may use the terms "useful," "lost," and "waste" work just as he pleases, but he really goes a little too far in eccentricity, when he says that the work done on the drag of a mine forms no part of the useful work performed by the fan. His reason has a delicious simplicity about it, viz., that all work done on friction or viscosity is "in the most rigorous sense of the term lost." Why! the fan is put in its place for the sole purpose of overcoming the drag. If there were no drag to be overcome, the mechanical work to be done would dwindle to an almost infinitesimal quantity. Does Mr. Graham contend that a locomotive drawing a train on a perfectly level line has no "useful" work to perform? If so the utility of locomotives must be rated by him at a very low figure indeed.

Professor W. C. Unwin complains that I occupied "one-fourth of the paper" with reference to him when he was not present at the meeting. He overstates the proportion devoted to him immensely, and, the discussion on the paper having yet to take place, I have not the slightest doubt that the secretary of the Institute will be glad to read to the society any reply he may wish to make. The reference to him was necessary because, instead of troubling the meeting with a tedious mathematical deduction, I referred them to a letter in your columns on the 19th December last. But the treatment of the question in that letter was attacked by Professor Unwin, and it was needful that I should show that his criticism was unfounded in order to maintain my statement that the formula I gave to the meeting was correct. The discussion in your journal, to which my letter above referred to was a contribution, arose altogether from a dispute as to the efficiency of the Cappel fan, which took place in the Mining Institute's meeting last year, and it was as a result of that discussion in your journal that the secretary asked me to read the present paper.

Professor Unwin now states that I "have come over to his view." I have simply to contradict this, as also the further statement that I "admit that the compression is not adiabatic." I hold now precisely the same view as I did when Professor Unwin attacked me. He did so on the ground that I used the adiabatic instead of the isothermal compression curve. By so doing he virtually asserted that the difference was one of practical importance. I stated last December, and I have now in my recent paper shown by numerical examples, that the difference was of no practical account, the whole term in which the difference occurs being very small; so that Professor Unwin's criticism, even if it were correct, was trivial. But even as to the matter of minute theory, I still believe him to be wrong, and that the compression in a fan is more nearly adiabatic than according to any other calculable thermal condition. Professor Unwin now explains that in his expression $2.45\,(p_2 - p_3)$ he meant p_2 and p_3 to be measured in feet of air at the different densities corresponding to these pressures. With this explanation I admit, as a matter of course, that it is correct, as, indeed, a single glance shows it to be. It is an odd idea certainly to measure two heads of air in two different units when the one has to be subtracted from the other in the same formula, and one may be excused for not recognising that this is being done when one is given no sort of warning of the fact. The practical utility of doing so may be doubted by ordinary people. But it is said that this odd device is "well-known," and that if I were "humble enough to consult" the text-books, I would be familiar with it; also that it occurs "in the first two pages of the chapter on thermo-dynamics in 'Cotterill's Applied Mechanics.'" It does not occur in these two pages, nor in any part of this chapter, nor in any part of this book—at least, not in the first edition, 1884, and I do not know that a second edition has yet appeared. It does not even appear in Cotterill's "Steam Engine," so far as I have been able to discover. I have read, I think, conscientiously nearly every important treatise on thermo-dynamics that has been written in the English and German languages, and I certainly do not remember having seen it in any one of them. But still, I admit it is correct, although very awkward and useless, and I freely withdraw my statement that it resulted in a quantity three and a-half times too much. But Professor Unwin's logic is at fault when he deduces that "my estimate was three and a-half times too small" from the fact that I said, under a misapprehension of the meaning of the symbols he was using, that his was three and a-half times too much. He knows, of course, that that is a false conclusion; and it is unfair to use such false logic, because it has certainly a chance of misleading some of your readers.

The paper contains one easily recognised error, due to its having been written hastily at one day's notice. It occurs in the sentence: "But this heat not being received by conduction, the compression curve remains adiabatic." This is wrong. If the work done by an expanding substance be entirely spent in generating heat which is wholly retained by the expanding surface, then the expansion curve in the case of a gas is isothermal. The same holds for compression under this condition. This error does not, however, affect in the least either my original position or anything in the present paper; because, as I contend, the above condition does not exist inside a fan.

Robert H. Smith.

Mason College, August 15th.

ENGINEERING CASES IN LAW COURTS.

Sir,—Your correspondent, Mr. M. P. Bale, in a letter under the above heading, drew attention to a point that has long appeared to me a matter of great practical importance, viz., the employment of assessors to aid the Court in trying cases of a technical nature. In Section 28 of the Patents Act, 1883, provision is made for calling in the aid of an assessor "specially qualified" to assist either the Court, the Court of Appeal, or the Privy Council. As regards the Court of Appeal and the Privy Council, the power is simply discretionary; but the words of the clause are: "The Court may, if it thinks fit, and shall, on the request of either of the parties to the proceeding, call in the aid," &c.

I have often witnessed a most serious waste of time in trials of patent cases—involving, of course, great increase of costs to the parties—owing to a want of technical power in the Court. I think it is quite a mistake to suppose that a strong bar and an imposing array of eminent scientific witnesses are all that is required to secure an efficient and satisfactory trial of difficult cases. Without adequate strength in the Court to control the technical evidence and the use made of it by contending counsel, it becomes very doubtful whether the usual mode of procedure is capable of dealing with difficult cases in such an effective manner as to prevent unreasonable loss of time, and to ensure reasonable certainty of result.

I have heard the late Sir W. Erle strongly condemn the practice of making one expert after another give evidence on the same scientific point. In his "Observations on the Constitution of the Court for the Trial of Patent Cases," he says: "Upon the trial of either of these issues—novelty or infringement—by the judge, if the question arises in the class of mechanical patents, a model or diagram, when understood, would dispose of questions of infringement and of prior use, and provision might be made for ascertain-

ing and furnishing to the judge correct models or diagrams, and explaining their mechanical effect with the aid of an expert." Then he makes a corresponding suggestion as to chemical patents, and adds: "If these issues were all for the judge, each might be tried separately, and the evidence might be confined to the point, and the intentional confusion, which is a frequent resource for the party in the wrong, might be excluded." It is clear that in Sir W. Erle's opinion—and he was a judge of great eminence—the strengthening of the Court by means of special technical information being supplied to the judge through an expert or otherwise is the important point to be secured. It is a singular fact, shown by the "Reports of Patent Cases," issued from the Patent-office, that the judges in the "Court of Session in Scotland" have been recently trying patent cases with the aid of assessors. If the practice is advisable north of the Tweed why is it not south of it?

I have understood that in Australia it is an universal practice to try cases by the aid of assessors "specially qualified," and is considered to have the effect of shortening trials, which is a matter of growing importance in England now that the number of patents has so largely increased. WILLIAM SPENCE.

8, Quality-court, Chancery-lane, W.C.,
August 17th.

RAILWAY COUPLINGS.

SIR,—In your article upon "Railway Couplings," published July 31st, you quote Mr. Broadhurst's question, put to the Secretary of the Board of Trade, as to whether that department "will depute one or more of their inspecting officers of railways to examine and report on the various improved railway couplings, designed with a view of minimising the risk to life and limb, now on view at the Inventions Exhibition, and if so will the Board of Trade recommend the adoption by the railway companies of such as may be favourably reported upon."

I see from the Parliamentary reports that Baron Henry de Worms replied to Mr. Broadhurst's question, to the effect that several of the inspecting officers were acting upon the jury at the Inventions Exhibition, and that these gentlemen had been instructed to report upon the subject in question. As a preliminary, it is no doubt quite right that the inspecting officers should examine the various forms of couplers now on view at the Inventions Exhibition, but it appears to me that it would be almost impossible to arrive at any satisfactory conclusion as to their respective merits by a simple inspection, and that in order to determine the most efficient types, a thorough trial in actual practice should be made.

Your article refers to a paper recently read before the Railway Commissioners of Massachussetts, upon the subject of automatic couplers. The author of this paper is Mr. William McConway, of Pittsburg, U.S.A., the manufacturer of the Janney coupler. A pair of these couplers is on view at the Inventions Exhibition, and as I have received a notice from the Commissioners that the jury have awarded me a silver medal for the exhibit—the highest award given for railway couplers—I shall be pleased to place at the disposal of the Board of Trade for experimental purposes a pair of the couplers in question, in order that they may be attached to any carriages or wagons, and thoroughly tested in practice. I have no doubt that the Board of Trade could make arrangements with one of the railway companies to test these and other types of couplers, and in this way, and in this way alone, a thoroughly trustworthy opinion can be obtained.

I may state in conclusion that the coupler with which I am identified, viz., the Janney, has been the standard upon the Pennsylvania Railway for passenger traffic for the last four years, and is now being applied to the freight trains on that railway, and has been adopted by no less than forty-five other railways in the United States of America. ALFRED DAVIS.

Parliament Mansions, Westminster, August 17th.

THE LAWS OF MOTION.

SIR,—I do not think anything would be gained in the way of promoting scientific truth by further discussion with Mr. Benson, who spends a great deal of time in endeavouring to prove to me what I have never denied, namely, that recoil takes place when a cross-bow, or a catapult, or a 100-ton gun is fired. I stated that a certain experiment could be carried out in such a way that the inertia of a body to be moved might be made to have a very small influence as compared with the frictional resistance which it would meet with, and that in such a case a certain result would be obtained. Mr. Benson, carrying out my instructions, got the stated result; extending his experiment quite beyond the range contemplated, he gets quite different results as a matter of course. I never said or supposed that it would be otherwise.

I must refer Mr. Benson to the first letter I wrote on this subject. Not one of your correspondents has adduced a shadow of proof that my propositions are unsound. They have assumed a great deal, proved nothing.

Even if I admit that force is the cause of motion, in the same sense that the draw-bar is the cause of the motion of a railway carriage, it would still remain to be proved that force was not caused by motion. This as Mr. Benson will see, if he refers to my first letter, I hold to be a fundamental proposition. Neither Mr. Benson nor any one else has ever attempted to disprove it. Dr. Lodge, indeed, indirectly admits it when he says that probably all energy is dynamic or kinetic.

Perhaps Mr. Benson may be able to hit on some apparatus which will disprove this proposition, or that he can devise some mathematical proof that it is untrue. If he can succeed in this, I shall be glad to see his statements in print, and to comment on them. Until then, as there seems to be nothing left to discuss with him, I must respectfully decline to go over old ground. Possibly a perusal of a new work by Professor Tait, viz., "Lectures on some Recent Advances in Physical Science, with a Special Lecture on Force," may serve to enlarge his views.

In conclusion, you will perhaps permit me to express my thanks to those who have taken part in this discussion for the uniform courtesy and patience which they have manifested in dealing with me. My thanks are also due to you, Sir, for the space you have afforded me in your columns.

London, August 19th. Φ. Π.

ENGINEERING IN CHINA.

SIR,—In the year 1876 the Woosung Railway was opened in China as a mere trial scheme. It proved very successful, and was expected to have been the commencement of a gigantic railway system in that country; but unfortunately, just at that time, the murder of Mr. Margary created disputes between the Imperial Government and our own, and the Governor of Nankin, diplomatically squabbling over the little line—nine miles long—eventually rooted it out. The engineer of the railway, however, said he "was not without hope of making a substantial introduction of a similar undertaking in course of time."

Can any of your readers kindly inform me what is now being done in that country regarding engineering generally? Have they been again induced to try another railway, however small? What is the state of steam navigation in that empire? Have many of our engines or machines in general been adopted in their manufactures? Does the telegraph, or telephone, or any other features of Western civilisation find acceptance among the Celestials? In short, are they much, or indeed any, better off in such matters than they were a hundred years ago? I never hear of any locomotive or steel rail orders emanating from China, and if any steamers are built for that country I suppose they are for foreign owners.

It strikes me, therefore, that there is a magnificent field for engineering enterprise in that region, if we could only get the "Heathen Chinee" to see those things as we do. I am afraid, however, that it will be rather difficult to accomplish this; and yet, it certainly is worth trying again; and I am the more convinced of the necessity of doing so on account of the very depressed state of affairs in England at the present time. Like Alexander of old, we want a new empire to conquer, as it were, with railways; and if we can only get them fairly started, I have no doubt all the other branches of the profession will follow, and among a nation of 450 millions we may reasonably expect great results for all concerned.

Cannot something be done to accomplish this? If so, then I think we may anticipate, before long, vast improvement in our trade and commerce. J. W. C. HALDANE.

Liverpool, July 27th.

THE DE BANGE GUN.

SIR,—In your impression of 14th instant I see you give drawings and illustrations of the new gun by Colonel De Bange. I perceive he trusts almost entirely to the steel tube to meet the longitudinal strain, with the exception, as I gather from the description—as the drawings fail to show it—that he has arranged the hoops to, as it were, dovetail, inasmuch as they are truncated cones, and in that way assist in overcoming that strain; but as the cones must necessarily be at such a very acute angle with the direction of the strain, it is difficult to see what is to prevent the inner tiers of hoops from acting as wedges upon the hoops encircling them, and consequently bursting them. Colonel Maitland has, however, entirely overcome these difficulties by bayonet jointing his hoops on to a collar on the tube, and by not having the breech screw in the tube at all. It will be highly interesting to see the difference in the personal appearance of the De Bange gun as it now stands in the Exhibition at Antwerp and after ten rounds with the charge the inventor proposes. CHAS. S. BERTHON.

Lieutenant 3rd Southern Royal Artillery.

THE ANTWERP EXHIBITION.

SIR,—We see your notice of this week on the Antwerp Exhibition, and that you will shortly say more about Messrs. De Näyer and Co.'s boilers. Would you kindly mention at the same time that we have covered all the steam pipes leading from these boilers to the various engines with our fossil meal composition? Mr. Stein, the chief engineer of Messrs. De Näyer's, who has also used our composition at the Amsterdam Exhibition, will be able to speak well of it—as he has told us himself. We have been awarded a silver medal at the Amsterdam Exhibition, and another silver medal at the Inventions Exhibition, where we have covered the boilers and steam pipes in the Electric Light Shed.

114, Fenchurch-street, London, A. HAACKE AND CO.
August 14th.

THE WATER SUPPLY OF PALERMO.

THE following correspondence has been transmitted to us by the Board of Trade for publication:—

Palermo, August 6th, 1885.

My Lord,—I have the honour to enclose herewith for the information of the public, a notice issued by the Municipality of Palermo, and published on the 30th ult. in the local papers, regarding the adjudication of the new waterworks to be constructed in the neighbourhood of Palermo, for the supply of wholesome water in addition to the inadequate supply already in existence.

Any British company wishing to undertake these works should send out immediately a staff of engineers to survey the country in the neighbourhood of Marineo, whence the water supply will no doubt have to come from. This locality is situated behind Monte Belmonte, which is a part of the chain that forms the "Conca d'Oro." The sources are high above the town of Palermo, and the mountain might be easily turned. I shall be ready to offer all the information and assistance required at my hands to enable a British company to undertake these works.

I have, &c.,
(Signed) HY. A. CHURCHILL.

The Right Hon. the Marquis of Salisbury, K.G., &c.

[COPY.]

Translation of a Notice published by the Municipality of Palermo, regarding the Water Supply of that City.

In view of supplying the town of Palermo with a sufficient quantity of drinkable water, the Municipal Administration has come to the decision to see which plan would be the best adapted to fulfil the following purposes:—

1. That the water come from sources springing naturally to the surface.

2. That it possesses all the qualities of drinkable water, satisfying all the conditions reported necessary to make it agreeable to the palate and salutary, and that the sole judge of this be the Municipal Administration.

3. That it be a quantity sufficient to supply the wants of this City, taking into account the supply already in existence, which amounts to about 13 zappe (475 gallons per hour), and the probable increase of the population.

4. That the water be carried to the highest parts of the town, and be capable of reaching the upper storeys of the houses.

5. That it be conveyed from the sources in open aqueducts or in cast iron pipes, and be distributed in the town in similar pipes or in wrought iron tubes, adopting the most reasonable methods and those which practice has hitherto sanctioned.

In consequence of which, all companies connected with this business, those whose speciality it is to supply water, and others, are invited to present within the term of two months counting from the date of the present notice, *i.e.*, up to mid-day on the 28th of September next, in the hands of the Syndic, a complete project with particulars relating to the technical as well as to the financial and administrative branches of the affair.

Notice is also given that a provisional guarantee of 25,000 lire (£1000) is to accompany the offers, and of an offer of a definite guarantee corresponding to one-tenth of the estimate of the works to be accomplished, to be paid up in case of the definite acceptance of the offer.

The provisional guarantee will be retained until the complete examination of the projects, after which, to those which will have been rejected, will be returned the amounts deposited, retaining only the guarantee of the accepted project, it being understood that the said guarantee will revert to the Municipality if the stipulated contractor does not come forward with the definitive guarantee.

The necessary stipulations will, according to law, be submitted to the approval of the Municipal Council and of the authorities, and only then will they become obligatory.

The Municipality reserves to itself the right of the rejection of any offers, without being obliged to indicate its motives for doing so.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, August 8th.

TO all appearances the limit of the industrial depression has not been reached. In certain quarters there is a strong pressure to a further curtailment. The anthracite managers have carried out the programme agreed upon last December; but just now stocks are heavy, and consumers are waiting for a crash somewhere. The coke region has suffered a reduction from 60 to 50 per cent., which throws out 800 ovens. The iron makers have blown out several furnaces to prevent the accumulation of unsaleable iron. In other industries similar statements are made. This condition of trade attracts notice, because a general improvement was confidently anticipated after August 1st. Railroad building is dull. Considerable interest is felt in the numerous projections of lines. When the reaction takes place an enormous volume of work will be precipitated on the market, and probably strain the capacity and create an artificial enhancement of values, as has been done before. The railroad managers are not able to present better reports. Economy is practical at the cost of durability. A scheme is on foot to take the Roach properties and reorganise a shipbuilding company, and secure an armour-plate plant from England.

Very little iron is selling. Coltness is offered at 19·50 dols.; Glengarnock, 19 dols.; Eglinton, 17·50 dols.; Bessemer pig, 18 dols. to 19 dols.; Spiegeleisen, 25·50 dols. for 20 per cent. Large sales of steel rails are made at 26·50 dols. at mill. Old rails are held at 16 dols. to 16·50 dols. Stocks of foreign material are light. Exports of copper continue large. For year since January 1st, 22,000,000 lb. refined and 35,000,000 lb. copper matte and ore. Large sales of lead have been made at 4·10 to 4·20. Tin-plates are in slow movement; stocks 50,000 boxes. Zinc is 5c. under an active demand. Foundry irons are 15 dols. to 18 dols. for Pennsylvania, and 14 dols. for Alabama forge.

Textile machinery makers have received a larger number of orders since July 15th than usual. The carpet factories are crowded with orders; the hosiery and knitting mills are busy. There are several inquiries for cotton spinning machinery from the Southern States; but just now a sluggish demand for goods due to an overcrowded market restrains enterprise.

The inquiries for iron and steel, hardware, wire, lumber, and building material, indicate that the work of shop and house building will be prosecuted actively until the close of the season.

The Eastern nail makers propose to erect a Bessemer steel plant to furnish material for nail plate.

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

(*From our own Correspondent.*)

WITH the view of keeping prices at as remunerative a level as possible, a few sheet iron firms have individually determined to run their works only alternate weeks. Such firms were yesterday in Wolverhampton and to-day—Thursday—in Birmingham strong in their quotations of £7 for doubles and £8 for lattens. The inquiries upon the market from galvanisers and for merchants on export account were numerous. Here and there ironmasters who have only one or two sheet mills were able to report themselves full of orders up to the middle of October.

A capital demand continues to be experienced by the thin sheet makers who are receiving orders from Australia, Canada and the United States, Germany and other continental markets, South America, and elsewhere. They have not all of them so many orders ahead as recently, but the arrivals are sufficient to keep certain of the makers fully employed. Prices are firm. Messrs. E. P. and W. Baldwin quote their Shield brand £9; Severn, £10; B., £11; and B.B., £12 per ton. Doubles are 30s. per ton extra upon the above. Steel stamping sheets are quoted £13 for 24 w.g., and 26 and 27 w.g. 30s. extra. John Knight and Co. quote working-up sheets an average of £10 10s.; steel sheets (singles), £12 10s.; and charcoal sheets, £19 10s. The extras for doubles on charcoal sheets are 30s. per ton, and on the other two descriptions 20s. per ton. Crowther Brothers and Co. quote their "Vale" singles £10 10s; B., £11; B.B., £12; and B.B.B., £13. Semi-charcoal is £14; charcoal entire, £15; and best ditto, £16 10s. per ton. Their steel sheets vary from £11 to £12 10s., and on to £13 10s., according to quality.

A moderate demand is expressed for bars and hoops, the Australian colonies, South America, and certain of the continental markets being encouraging customers. Second and third-class qualities of bars are chiefly selling, the quotations for the former being £6 10s. down to £6, and for the latter £5 10s. down to £5 5s. Marked bar makers who adhere to the full £7 10s. are not generally busy.

The New British Iron Company quote:—Best Corngreaves angle bars from 1in. by 1in. by ¼in., and up to 8 united inches, and 25ft. long, £7; "Lion" ditto, £8 5s.; best Lion, £9 15s. Best Corngreaves, T-bars, 1¼in. by 1¼in. by 1¼in., and 21ft. long, are £7; Lion ditto, £8 10s.; and best Lion, £10. Best Corngreaves window sash bars, from ⅜in. to 3in. wide, are £8 10s.; Lion ditto, £9; best Corngreaves horseshoe bars, £6 10s.; Lion, £7 10s.; and best ditto, £9. Fancy irons, such as oval, convex, half round, round cornered, round edged, bevelled, and beaded tire bars are also £6 10s., £7 10s. and £9, according to brand.

The list of the same firm for slit rods, &c., is:—Best Corngreaves rods, £6 5s.; C.G.C., £7; Lion, £7 10s.; best Lion, £9; best charcoal, £11 10s.; steel, £8; best Corngreaves slit horseshoe, £6 10s.; Lion slit horseshoe, £7 10s.; and best Lion, £9. Hoops and strips from 15 to 19 b.g.; best Corngreaves, £7; Lion, £8; best Lion, £9 10s.; best charcoal, £12; and steel, £8 10s.

Competition in prices among the edge tool firms keeps up. Cutting tools, as axes, adzes, bill-hooks, cane knives, and so forth, are to be had at a lower price than ever before, yet the quality improves almost in the same ratio as prices become lowered. This is brought about by the remarkable progress, indicated in my last, which the steel-makers are showing both as to uniformity and excellence of quality, and in the rapidity with which steel can be rolled after it has been run out of the converters.

The makers of steel both on the West Coast and on the Tees, no less than in South Wales and in Sheffield, are all seeking business amongst the large tool makers as well as amongst the rail users, but in the making of steel suitable to the uses of the edge tool firms, the steel firms in Wales are perhaps displaying most enterprise.

The Blaenavon Company, it is understood here, has gone somewhat extensively into the plating and bar trade, and has considerably extended its productive capabilities in that department.

The pig iron trade does not show very much movement, yet native prices are fairly maintained by reason of production being on a par with the consumption. Hot blast all-mines are quoted 57s. 6d. and 60s., second-class pigs are 40s. to 45s., and common, 33s. to 35s.

The coal trade is without increased activity in the furnace and mill and forge branches, but domestic sorts are in better demand.

Operations at the bridge and girder works are fairly kept up at present.

Full time has been resumed at the Locomotive Works, Wolverhampton, of the Great Western Railway Company, where for several months the numerous hands have been upon only five days a week.

The strike in the cable chain trade at Cradley Heath, Old Hill, and Tipton, which has lasted over two months, has now virtually terminated. Messrs. Hingley and Sons, Messrs. Wood, Aston, and Co., and Messrs. Taylor have each conceded an advance of 25 per cent., and the operatives have resumed work. Those operatives, however, at factories where an advance is refused have decided to stay out on strike until a satisfactory arrangement has been made. The anchor smiths have had to resume at a reduction of 7 per cent. During the week meetings of the men have been held, and it was resolved that a Trades Union be formed to consist of factory men and also of out-workers.

The strike in the vice trade of Dudley and district, which has lasted over four months, has been settled, and the whole of the operatives are now at work.

At a meeting of the Birmingham and District Railway and Canal Rates Association the case of Kempson *versus* the Great Western Railway Company was again considered. It was decided that the Association should still continue to take action, because in case of an appeal funds would have to be provided and organisation secured. It was agreed that the Association should have a more definite combination with Lord Henniker's Committee, and also that the committee should be looked upon as a pivot for the organisations throughout the country to work upon.

A short length of cable chamber has been put down in Snow

Hill, Birmingham, by the authority of the Tramways Committee, to discover whether the narrow slot through which the cable is connected with the cars really causes inconvenience to the ordinary traffic. The slot is not more than ⅝in. wide.

Under the head of "A New Trade for Birmingham," a writer this week, after referring to the manufacture of locomotives, which has been allowed to pass altogether from Birmingham and district, hopes that the manufacture of tramway engines will be secured in its stead. This trade, he says, is only in its infancy, and will undoubtedly speedily develope into very large proportions.

An action of considerable importance to chain cable makers has just been heard at Grimsby. John Parker Hall, of Sheffield, bought from Jesse Billingham and Sons, Cradley Heath, sixty fathoms of tested chain cable, but when Mr. Hall sold it to a man at Grimsby to be employed in a fishing smack, the Board of Trade surveyor refused to pass it because it was not marked as tested by the Board of Trade. Mr. Hall then brought an action against Messrs. Billingham to recover £17 18s. for breach of warranty. The plaintiff contended that the Chain Cables Act, 1877, required all chain cables to be tested and marked by the Government. The defendants, on the other hand, urged that all makers had their own appliances for testing cables, and to enforce the Government test in every case would revolutionise the trade. If a person bought a Government-tested and officially-marked cable, it was so understood at the time. In summing up the case, the judge observed that the object of the Act was to make it quite certain that all cables supplied should be tested and marked by the Government, and a verdict for the plaintiff was given.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Reports week after week as to the condition of the iron trade in this district are practically but a repetition of the general complaints as to the continued absence of improvement, and the market shows no variation from the persistent tendency in a direction adverse to makers and manufacturers which has so long been the prevailing feature. So far as pig iron is concerned—both hematite and ordinary qualities—the requirements of consumers continue extremely small; and as the probabilities are certainly not of prices being any higher, these are only covered as the iron is actually wanted. Very much the same remarks also apply to manufactured iron, and the result is that business all through drags on from hand to mouth at prices which under the most favourable circumstances barely cover the cost of production; whilst the market is weighted down by the discouraging prospect that there is nothing in the immediate future to indicate a possibility of improvement.

The attendance in the Manchester iron market on Tuesday was very poor, and business throughout extremely flat. For pig iron the current quoted rates were no lower than those of last week, but in most cases makers are open to entertain offers where some slight concession on their list rates will lead to business. Where, however, buyers have orders to give out of any weight, they are offered at prices so much under quoted rates that makers do not care to accept them, and the bulk of the business done is confined to small retail purchases to cover any pressing requirements of work actually in hand. For Lancashire pig iron makers still quote 51s. to 51s. 6d., less 2½, delivered equal to Manchester, but for firm offers some concession on these figures might be obtained. District brands average 37s. 6d. to 38s., less 2½, delivered here, and both Scotch and Middlesbrough irons are offered in this market at very low prices.

Hematites are without change, and good foundry qualities delivered into the Manchester district are still quoted at about 51s. to 51s. 6d. per ton, less 2½.

In the manufactured iron trade there has been rather more doing in sheets, and some of the makers being now tolerably well supplied with orders are, for certain sections, asking slightly higher prices, good qualities of Staffordshire sheets being quoted at £7 to £7 2s. 6d. per ton delivered into this district. There is, however, no general advance in prices, and local made sheets are still to be got at about £6 15s. per ton, delivered equal to Manchester. For bars and hoops the demand continues very poor, and prices remain at about £5 5s. for local and North Staffordshire bars, and £5 15s. for local made hoops delivered into the Manchester district.

In the engineering branches of industry the tendency of trade continues practically the same as last reported. The inquiries coming forward are very limited in weight, and only a very small percentage of these lead up to actual business. Here and there in some special lines establishments are kept busy, and in finishing orders there is still a moderate amount of employment for a few of the works in the district. The departments specially engaged in the preparation of new work are, however, in nearly all the large firms of the district very slack, and the number of pattern-makers at present out of employment is larger than has been known for some years past. As orders in hand run out, men are being constantly discharged owing to the absence of new work coming forward to keep them going, and the returns of the engineering Trades Union societies show a steadily increasing number of members thrown on their books for out-of-work support.

The dispute at Messrs. Ashbury and Co.'s Railway Carriage Works on a matter practically of shop discipline, and which resulted some time back in a turn out of the whole of the smiths, is now at an end by the men having given in to the terms laid down by the employers. Practically, so far as Messrs. Ashbury are concerned, they have all along been masters of the situation, as they have had no difficulty in finding hands elsewhere; and the men, although backed up by the Amalgamated Society of Engineers, have found themselves powerless to insist upon the conditions they sought to impose upon their employers. This, although only an isolated case, may be taken as a sign of the times.

The inaugural meeting of the Manchester Chemical Club in their new rooms at the Victoria Hotel was celebrated by a dinner on Tuesday evening, which was followed by a very interesting address from Mr. Heys, in which he gave a description of the practical application of telephony and its rise and progress. The chair was occupied by Mr. Levinstein, the president, and with the aid of apparatus placed at the disposal of the meeting by the Lancashire and Cheshire Telephone Company, a very entertaining evening was spent. The room was connected to the Princess Theatre, and the orchestra and the music and voices on the stage were heard simultaneously by a considerable number of the members. Afterwards the room was connected to Liverpool, and a conversation carried on between the two places. Messrs. W. T. Glover and Co., of Manchester, also exhibited a collection of telegraph, telephone, and electric lighting cables; also armoured cables and several special double conductor cables for electric light cargo lanterns, which enables these lanterns to be hoisted up and down in the ship's hold without any interference with the circuit of the electric current. A small fragment of the first Atlantic cable was also shown by Mr. Glover, and as a curiosity attracted much interest.

The promoters of the Manchester Ship Canal, as I announced last week, have taken the earliest possible opportunity, after the passing of the Bill, to call together the subscribers to the promotion expenses, and a crowded and enthusiastic meeting was held on Wednesday afternoon in the Manchester Town Hall. Mr. David Adamson, who occupied the chair, delivered an interesting address, in which he narrated the steps the promoters had taken to secure the passing of the Bill, and urged the claims of the scheme for support, not only as a great boon to the trade and industries of the district, but as a successful commercial investment. A vote of thanks having, on the motion of Mr. Agnew, M.P., been passed to the committee, subscribers, counsel, witnesses, and others concerned in the promotion of the Bill, Mr. Reuben Spencer moved, and Mr. Mitchell, president of the Wholesale Co-operative Society — one of the largest trading concerns of the world—seconded a resolution expressing unabated confidence in the scheme, and pledging the meeting to do all in its power to raise the necessary capital for the completion of the work. This was supported by Mr. Alderman Husband, ex-Mayor of Salford, Mr. Fielding, and in response to the calls of the meeting by Mr. Alderman Bailey, who in a humorous but very forcible speech dealt with the objections which had been raised by the opponents of the scheme, and pointed out the advantages which would accrue from the carrying out of the canal, which, he said, if even the railway companies should so far attempt to compete with it by carrying the goods to Liverpool for nothing, would still be a cheaper means of transit, The resolution was carried with enthusiasm, and the scheme, which is meeting with very satisfactory offers for support, may now be considered as fairly launched pending the preparation of the prospectus, which will shortly be issued.

The coal trade, except that there is a slightly increasing inquiry for house-fire coals for forward delivery on the basis of the present low rates, is without improvement. Common round coals for steam and iron-making purposes and engine classes of fuel are very bad to sell, and stocks as they accumulate at the collieries are forced upon the market at extremely low prices. The average quoted rates remain at about 8s. to 8s. 6d. for best coals, 6s. 6d. to 7s. for seconds, 5s. to 5s. 6d. for common coals, 4s. 3d. to 4s. 9d. for burgy, 3s. 6d. to 4s. for best slack, and 2s. 6d. to 3s. per ton for ordinary qualities.

The verdict passed by the coroner's jury who inquired into the recent disastrous explosion at the Clifton Hall Colliery continues to be called in question, and Messrs. W. Pickard and S. Woods, who attended the inquest on behalf of the Lancashire Miners' Federation, have presented a report, in which they most emphatically protest against the verdict as "quite antagonistic to the bulk of the evidence produced." They also urge that the Government Inspectors ought to have taken legal means to compel the colliery owners to use safety lamps, and that the present system of mining inspection is not at all adequate for present needs of the mining population.

Barrow.—The improvement noticed last week in the demand for hematite pig iron, chiefly on Russian account, has disappeared, as was expected, after some 20,000 tons, or less than a week's production for the district, had been bought at the low prices ruling for delivery throughout the year. The demand from all sources is again dull, and it is fully expected that the largely augmented stocks, the rate at which iron is still being made in excess of the sales, and the indisposition of users to buy forwards, must be taken as proofs of the necessity which is being forced on producers to pull down the production by the blowing-out of some of the furnaces now producing iron. The output of the district is not much more than half of its capabilities, but steel-makers, who are very badly off for orders in all departments, are as a consequence using a smaller amount of iron, so that makers of the latter are suffering not only from a general inactivity in the demand, but from the special cause of less being used by steel-makers. No new orders have been booked by shipbuilders, but it is confidently expected that a share of the Government contracts now being given out will come to Barrow; and the enterprise which is being shown of the new limited company, with half-a-million of capital, in giving the order at Birkenhead for four new passenger steamers to open up a new route to the Isle of Man, is having the effect of impelling the present companies to put on new and fast steamers to compete with any opposition which may arise. It is reported that the Isle of Man Steampacket Company is giving the order for another fast steamer of the type of the Mona's Queen, which was built at Barrow last year, and which in ordinary weather is steaming twenty knots an hour, and that the Barrow Steam Navigation Company is about to place the order at Barrow for another steamer, which shall carry passengers to or from Douglas in two hours. If this work comes to hand, of which there is every probability, the trade in Barrow during the ensuing six months will be of a satisfactory character. Owing to several serious cracks in the masonry of the tower of the new municipal buildings in Barrow, it is found necessary to pull a portion of it down, and the chances are it will be necessary to take the structure down to the foundations and re-build on a firmer basis.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

There is every expectation of another attempt to agitate the miners with a view to demanding an advance when the cold weather comes on. In a letter addressed to the miners of several large collieries in this district a few days ago, the Union officials strongly counselled the colliers to join the Association, so as to be ready "to prepare for the coming winter and an advance of wages." If the men have not learned wisdom by recent disastrous disputes in the coal-field, they will follow this advice. At the present moment many of them are suffering from inadequate employment, simply because while former agitations were being conducted to the bitter end of strikes and lock-outs, the orders which usually came into this district have gone to the North-country coal-fields. The miners of Chapeltown, Tankersley, Thorpe, High-green, and Hoyland, who are specially appealed to by Union officials, may reflect on the results of the last strike before they prepare for another.

Local firms have been very successful at the Inventories Exhibition. Messrs. Wm. Jessop and Sons, Brightside Steel Works, have carried off both a gold and a silver medal; Messrs. Glossop and Stacey, Heeley Bridge Foundry, have been awarded the silver medal for their patent steam hammers; Messrs. Richard Hornsby and Sons, Spittlegate Ironworks, Grantham, have gained two gold medals and two silver medals. Messrs. Hornsby are sending out their new string binders at the rate of seventy a week.

Messrs. Watson, Moorwood, and Co., of the Harleston Ironworks, Harleston-street, Sheffield, are now engaged upon four chilled rolls for a Middlesbrough firm. These rolls are 36in. in diameter by 9ft. long in barrel, and long over all; the weight, when turned, of each roll is nearly 17 tons. One roll was completed this week, and was a fine piece of workmanship, being without a flaw over the whole surface, and the chill was equal all round at both ends alike. Staffordshire at one time had a monopoly of this class of work, but recently Sheffield firms have entered into the trade, and several manufacturers are now running the Staffordshire houses very close both for the home and export business.

About £1000 damage was done by a fire at Corton Wood Colliery, near Wombwell, on Friday. The screens on the pit bank, over which the coal is passed, had accidentally ignited. The mining population were greatly alarmed when the "buzzer" sounded through the valley.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The present week must be considered quite an abnormal one as regards the iron trade, Stockton Races forming the disturbing element. Without exaggeration they may be described as the carnival of Cleveland. All the industrial world goes demented as thoroughly and effectually as men usually do at Glasgow fair. This week the Stockton works have been idle in every case, and at Middlesbrough only a few have continued at work. The attendance at the Exchange on Tuesday was thin, and but few transactions took place. The general tone of the market was certainly no worse; indeed, there were indications that a return of confidence is not very far off. The remarkable rise in the value of railway property in the United States and Canada during the last week or two has made a profound impression, and the spectacle of British railway shares following suit has not been lost upon those who are on the look-out for better things. Again it is certain that the stocks in Connal's stores are increasing week by week, showing that capital is again flowing into the iron trade. The pig iron exports also are better, proving that the same feeling prevails abroad; and altogether there seems to be a widely diffused disposition to regard the future with hopefulness and confidence.

No. 3 g.m.b. varies in price from 31s. 10½d. to 32s. f.o.b. Middlesbrough, and No. 4 forge is offered at 31s. Warrants are 32s. 6d., and there is a considerable demand for them. The quantity in store was increassd by 2368 tons during the week, making a total of 65,259 tons. Exports have amounted so far to 42,358 tons, against 37,536 tons for the corresponding portion of July.

In the finished iron trade prices do not improve, but the few firms who now compete for orders keep regularly employed. Plates are still offered at £4 15s.; angles at £4 10s.; and bars at £4 17s. 6d., which are the same prices as have been quoted for several weeks. Steel plates and angles remain at previous prices. The Eston Steel Works, after remaining a week idle, resumed operations on Monday last.

The manufactured iron trade is to witness another wages arbitration, the employers having put forward a claim for 7½ per cent. reduction of wages. This amount is just what will bring them down to the level which would be yielded by Dale's scale of 1s. 6d. above shillings for pounds. The last award was given by Dr. Watson in January last. Notwithstanding that the scale then showed a reduction equivalent to 5 per cent., he allowed nothing, as he wished both parties to concentrate their energies on the formation of a new scale. Several months have elapsed, and after much contention it has been found impossible to adopt the arbitrator's advice. The operatives meanwhile have profited greatly by the delay, for they have staved off for so long the otherwise inevitable reduction. Recently they threw off all disguise, and appeared in their true colours. At the last meeting of the Board they said in effect: "We will have no scale but our own, and we will not agree to arbitrate as between that and any others. And it shall be a condition of ours that wages are not, under any circumstances, reduced below their present level." The primary object of the employers being to get immediate relief by a reduction, they would not, of course, accept any such conditions, and therefore all idea of a scale has been for the present abandoned. A regular arbitration to fix wages' rates is the alternative to be adopted. The Board will meet on Monday next to fix who the arbitrator is to be.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

There has been a somewhat more cheerful feeling in the iron trade this week, due partly to the rise in American railway stocks and to reports that have been current as to a probable early revival in trade. The past week's shipments of Scotch pigs were rather better, amounting to 9839 tons, as compared with 7031 in the preceding week, and 11,484 in the corresponding week of 1884. By the blowing out of a furnace at the Wishaw Ironworks of the Glasgow Iron Company, the number in blast has been reduced to ninety-two as compared with ninety-six at this date last year. The increase of stock in Messrs Connal and Co.'s Glasgow stores continues, and for the past week it has amounted to 1500 tons.

Business was done in the warrant market on Friday last at 41s. 1½d. cash. On Monday previous the quotation was 41s. 1d., and in the afternoon 41s. 2d. and 41s. 1½d. were quoted. Transactions took place on Tuesday up to 41s. 3½d. cash. Business was done on Wednesday from 41s. 3½d. to 41s. 4½d. To-day—Thursday—the market was strong in the forenoon, with business up to 41s. 6d., closing in the afternoon at 41s. 5d.

The market values of makers' iron are as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 46s. 6d.; No. 3, 44s.; Coltness, 48s. 6d. and 45s. 6d.; Langloan, 47s. 6d. and 45s. 6d.; Summerlee, 46s. 6d. and 44s.; Calder, No. 3, 44s; Carnbroe, 45s. 6d. and 43s. 6d.; Clyde, 46s. and 42s.; Monkland, 41s. 6d. and 39s. 6d.; Quarter, 41s. and 39s.; Govan, at Broomielaw, 41s. 6d. and 39s. 6d.; Shotts, at Leith, 48s. and 47s.; Carron, at Grangemouth, 51s. and 47s.; Kinneil, at Bo'ness, 44s. and 43s.; Glengarnock, at Ardrossan, 46s. and 41s. 6d.; Eglinton, 41s. 3d. and 38s. 3d.; Dalmellington, 43s. and 39s. 6d.

The past week's shipments of manufactured articles from Glasgow embraced machinery to the value of £2000. Sewing-machines, £2126; a small steam vessel valued at £1600 shipped to Calcutta; steel goods, £1100; and iron manufactures, £10,100.

In the coal trade there is, on the whole, less activity, although the shipments at some of the ports have been considerable. At Glasgow, about 21,000 tons were despatched, 1488 at Greenock, 3272 at Irvine, 7339 at Troon, and 13,155 at Grangemouth. Coal-masters and merchants complain of the low rates to which the coals are being depressed by the competition, which becomes greater as the trade slackens.

The agitation among the miners for increased wages gathers some more strength, and in some cases employers do not disguise the fact that they would not altogether be displeased were the men to succeed. If the miners obtained an advance, it would be the means of adding something to the price of coals. The thing to be feared is that the increase might be obtained in a few localities, leaving the rest to sell at the old rates. In this way customers would be lost, and the wages probably forced back all over to the former rates. An effort is to be made to so organise the colliers in the various localities as that they shall act in concert, but such a plan has very seldom been attended with success.

Messrs. Russell and Co., shipbuilders, Greenock, have contracted to build an iron sailing ship of 1500 tons for Mr. James Nourse, London. Contracts are at present few, in consequence of the unprofitable nature of the shipping trade.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

The coal trade of Wales is getting into a very serious state. Hitherto I have been able to find signs of partial activity, and even when the house coal trade has been dull some of the large steam collieries have been busy. Now there is depression everywhere. House as well as steam is suffering. The Llantwit Colliery, near Caerphilly, is stopped altogether, and in many half work is regarded as good. At Hirwain, on the one hand, and Ferndale on the other, it is the same tale, "two or three turns per week," and colliers who have been prudent and have saved a little are availing themselves of the temporary slackness by taking a holiday.

House coal prices are easy, but little trade can be done even by forcing. No. 2 is quoted at 8s. 3d. and No. 3 at 8s. 9d. Steam coal quotations are unsteady, and some of the best collieries are remarkably quiet in their operations; yet I am glad to note that in the matter of shipments Cardiff last week showed an improvement of 12,000 tons. But Cardiff, Newport, and Swansea have all to complain of dulness, and coalowners and shippers are not unreasonably asking why this special slackness should not be as special a feature of Government inquiry as weaving and ribbon work. The colliers of Glamorgan and Monmouthshire number about 60,000 men, and when these are only half employed an inquiry is called for.

The iron shipments of the week from Cardiff and Newport, Mon., amounted to 5300 tons, of which the most important items were a cargo of 1600 tons to Rio de Janeiro, and another of 1300 tons to Messina.

In tin-plate substantial consignments of more than 2000 tons have been sent to Baltimore and Philadelphia. The attitude of makers is firm, and prospects of a better trade at improved figures are now regarded as certain. Quotations remain steady, and makers having no large accumulations of stock to trouble them, are evidently calculating upon a fairly remunerative trade in future.

Here I must record one rumour, given on authority, that a large firm have accepted a considerable order, at prices deemed below the margin to yield any profit. This is only one case. As a rule makers are firm in refusing, and buyers are content with taking only small quantities, hoping to break down the confederacy.

I am glad to know that there are prospects of the Penygraig Colliery difficulty being settled. The men have decided to accept arbitration, two arbitrators and an umpire to be elected, the award to bind both parties; the manager and overman to be suspended during the enquiry; the wages now due to be paid; the workmen to resume work forthwith, and all summonses to be withdrawn.

NEW COMPANIES.

THE following companies have just been registered:—

Arthur B. Dashwood and Co., Limited.

This is the conversion to a company of the business of horticultural engineer, carried on by Mr. Arthur Dashwood, 28 and 29, St. Swithin's-lane, and at the Sycamore Works, Wimbledon. It was registered on the 6th inst., with a capital of £30,000, in £10 shares. The purchase consideration is £3600 in fully-paid ordinary shares, and 3000 fully-paid deferred shares. The vendor is to undertake the management for not less than ten years at a salary not exceeding £4 per week, and a commission of 5 per cent. on the net profits. The subscribers are:—

	Shares.
John Freeman, Farnborough, Hants	20
J. Clever, 54, New Broad-street, architect, &c.	20
P. J. Pool, 4, Bishopsgate-street, colonial agent	20
W. W. Whitehead, Beacon Lodge, Sevenoaks	5
A. C. Blackall, 4, Bishopsgate-street Within, insurance broker	1
P. Dashwood, 75, Mark-lane, surveyor	10
J. B. Dashwood, 75, Mark-lane, land agent	1

The number of directors is not to be less than four, nor more than six; the subscribers are to appoint the first, and are to act *ad interim*; qualification, 20 shares; the company in general meeting will determine remuneration.

Indian Midland Railway Company, Limited.

This company proposes to carry into effect a contract dated 10th inst. between the Secretary of State for India in Council and Mr. Thomas Rossiter Watt, to construct and work lines of railway in the East Indies from Bhopal to Jhansi, and thence in one direction to Gwalior, and in another direction to Cawnpore, and in a third direction to Marukpur, with junctions at Cawnpore and Marukpur with the system of the East India Railway Company and of the Oude and Rohilcund Railway, a junction at Gwalior with the Sindhia State Railway, a junction at Bhopal with the Bhopal Railway, and a line from the first-mentioned line at or near Etawah to Sauger, and thence to Katrir, with a junction there with the railway system of the East Indian Railway Company and the Bilaspur State Railway. It was registered on the 11th inst. with a capital of £3,000,000, in £20 shares. The subscribers are:—

	Shares.
*Col. James Holland, The Park, Upper Norwood	50
*Major-General J. S. Trevor, R.E., 75, Ladbroke-road, Notting-hill	50
*Major-General Harry Rivers, R.E., 31, Arundel-garden, W.	50
*F. S. Chapman, 36, Stanhope-gardens, S.W.	50
*Andrew R. Scoble, Q.C., 21, Kensington-gardens-terrace	50
*A. H. Campbell, 8, Cornwall-gardens	50
*H. Wollaston Blake, 8, Devonshire-place, W.	50
*Lieut.-General Sir H. D. Daly, Ryde, Isle of Wight	50
*T. R. Watt, The Briars, Chislehurst	50

The number of directors (exclusive of a Government director) is to be nine; qualification, 50 shares; the subscribers are the first. Remuneration of the directors is fixed at £2000 per annum.

Amalgamated Sulphuric Acid, Copper, and Phosphate Company.

This company proposes to acquire and work 10,395 acres of mines and lands in the eastern township of Lower Canada; 200 acres of lands and phosphate mines thereon, situate near the Du Lievre, Ottawa; and land at the village of St. Henri, in Montreal, for the erection of a sulphuric acid manufactory. It was registered on the 8th inst., with a capital of £300,000, divided into 15,000 preference and 15,000 ordinary shares of £10 each. The purchase is regulated by three agreements of the 30th ult., the consideration for the property first mentioned being £75,000, payable as to £41,250 in ordinary shares, and the balance in cash, or fully-paid preference shares, at the option of the vendor; for the second-mentioned properties the consideration is £100,000, payable as to £50,000 in fully-paid ordinary shares, and the balance in cash or preference shares; for the property in Montreal the consideration is £10,000, payable £2000 in cash, £4000 in fully-paid preference shares, and £4000 in fully-paid ordinary shares. The subscribers are:—

	Shares.
Walter Bird, 7, East India-avenue, merchant	2
R. Fennell, 4, Copthall-buildings, secretary to the Estramuda Phosphate Company	2
E. H. Cannon, 4, Plowden-buildings, Temple, barrister	2
A. J. Lambert, 4, Copthall-buildings, merchant	2
J. W. Maclure, J.P., Whalley Range, near Manchester	2
B. Hardy, Gordon House, Chiswick, coal merchant	2
J. M. Kelly, 12, Charlotte-street, Bedford-square	2

The number of directors is not to be less than three, nor more than seven; qualification, 100 shares; the subscribers are to appoint the first and act *ad interim*; remuneration, £1500 per annum, and an additional £300 for each £1 per cent. dividend over 10 per cent. per annum.

Brown's Patent Fuel Economising and Smoke Consuming Company, Limited.

Upon terms of an agreement of the 20th ult., this company proposes to acquire and work the patent No. 7050, dated 30th April, 1884, granted to Edward Honychurch, of 52, Selwood-street, Rotherhithe, for improvements in steam boiler furnaces and appliances for economising fuel and consuming smoke. It was registered on the 11th inst., with a capital of £2000, in £10 shares. The purchase consideration is £500 cash and £1000 in fully paid shares. The subscribers are:—

	Shares.
A. H. W. Brown, 1, Waterloo-place, S.W., naval architect	1
H. W. Gimblett, 9, Saunders-road, Notting-hill, draughtsman	1
A. F. Coe, 14, Hart-street, Bloomsbury, solicitor	1
*F. S. Boully, Blackheath Dale, stock dealer	1
*W. O. Robinson, Belvedere, Kent, Stockbroker	1
C. W. Heaton, Charing-cross Hospital, professor of chemistry	1
Owen D. Robinson, Belvedere, Kent	1

The number of directors is not to be less than two, nor more than five; the first are the subscribers denoted by an asterisk.

Italian Ironworks and Mining Concessions Company, Limited.

This company proposes to acquire land and hereditaments, situate at Tofe, near Civita Vecchia, Italy, together with mines and quarries of iron, ironstone, iron ore and other metals, and also foundries, works, &c., situate at Terni, near Rome. It was registered on the 7th inst., with a capital of £5000, in £5 shares. The subscribers are:—

	Shares.
F. Carrel, Woolpack-buildings, Gracechurch-street, merchant	10
F. Fox, C.E., 2, Victoria Mansions, Westminster	5
F. Tallack, Windsor-chambers, Great St. Helens, shipbroker	10
C. Douglas Fox, C.E., 2, Victoria Mansions, S.W.	10
H. R. Gill, 61, Ludgate-hill, solicitor	1
C. A. Head, Hartburn Hall, near Stockton-on-Tees	5
T. Wrightson, Norton Hall, near Stockton-on-Tees	5

Registered without special articles.

TORPEDO BOATS.

THE Admiralty, having taken into consideration the special character both of the hull and machinery of first and second class torpedo boats, have issued a series of regulations for their more effectual preservation. After reminding officers in charge of the craft that they are built of very thin steel—only $\frac{1}{16}$in. thick—and that the utmost care is required in their management, their lordships order that no portion of the hull should on any account be devoid of paint or other anti-corrosive composition in good condition. The bottoms of all torpedo boats in the reserve which are not in use are to be coated with red lead only, and not with experimental composition. Whenever practicable the boats are to be hauled up or docked for examination every two months, and the interval between such examinations is never to exceed four months. In order to reduce the amount of corrosion to a minimum, should any of the inside of the vessel be bare of paint or composition, pieces of zinc are to be placed on the inside of the vessel, as low down as possible, so as to be immersed in bilge water should there be any. The zinc should be in metallic contact with the frames of the vessel, or other parts of the structure if preferred, and the arrangements should be made under the advice of the Admiralty chemist. Before any torpedo boat is laid up or placed in store the engines are to undergo a thorough examination, and any defects that may be discovered are to be reported and, if possible, made good at once. If this is not practicable the defects are to be made good as soon as possible after the boat is stored. If the boat has been attached to a ship, before being returned to store the chief engineer of the ship is to make good the defects as far as possible. The engines are to be thoroughly disconnected; the whole of the working parts are to be cleaned and oiled and re-adjusted. The internal parts are to be drained out, and all the doors and covers are to be so left that periodical examinations may be made of the interiors. The after part of the propeller shaft is to be withdrawn, so that it may be cleaned and oiled, and the stern tube is to be drained out and painted, or otherwise put into a state of preservation before the shaft is replaced. The engines are to be turned several times every week, the boiler is to be thoroughly washed out with fresh water, and the chief engineer is to superintend the examination and see that the fire-box and tube-plate are properly gauged, to ascertain if they have received any injury during the time the boat has been under steam. The safety valve and all other boiler mountings are also to be examined, but the safety valve spring is not to be screwed down. After being washed out the boiler is to be gently warmed to a temperature well above that of the atmosphere and then closed and kept so. If unslaked lime can be readily obtained, a small quantity in suitable pans is to be laid on the top of the tubes before closing up the boiler, but the boiler is not to be kept open more than a day or two for this purpose. The bilges are to be cleaned and the bunkers cleared of coal, and the interior of the boat is to be examined throughout, the lining of the bunkers being removed for that purpose if necessary. Any damage to the paint work is to be at once repaired, and the boat is to be put in every respect in as good a condition, both as regards her machinery and her cleanliness, as when she was issued from store. The Admiralty have authorised some important experiments to be conducted at Portsmouth with the object of determining the value of liquid fuel for the use of ships of war. There are various systems before the world, but the particular system which is to be tried is that of Baron Adelsward, which has been largely introduced into the French Navy. The coal oil is placed in a tank, where it is raised to a high temperature by steam from the boiler. It is then allowed to pass to the furnace doors, where it comes into contact with a jet of steam and is driven into the furnace, which has been previously heated in the usual way. The inventor claims that his system is suitable for the propulsion of armour-clads, but the experiments at Portsmouth will be confined to No. 22 torpedo boat, one of the boats of the largest type, which have lately been received from Messrs. Thornycroft. Should the trials prove successful, there can be little question of the superiority of the liquid fuel over coal for consumption in these small craft, quite apart from the question of economy. In the first place there will be no stoking required, thus enabling the complement on board to be reduced, and in the next place there will be no necessity for the use of forced draught and the arrangement of fans by which it is produced. These are important advantages when the confined space below deck in the torpedo boats is considered.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending Aug. 15th, 1885:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 11,127; mercantile marine, Indian section, and other collections, 3853. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 6 p.m., Museum, 1304; mercantile marine, Indian section, and other collections, 305. Total, 16,589. Average of corresponding week in former years, 19,379. Total from the opening of the Museum, 24,220,814.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

11th August, 1885.

9529. STUDS and SOLITAIRES, L. P. Conard, London.
9530. TELEPHONIC TRANSMITTING INSTRUMENTS, S. P. Thompson, London.
9531. FLAVOURING AERATED BEVERAGES, &c., W. Duckworth, Halifax.
9532. VELVETS or VELVETEENS, J. T. Taylor, Manchester.
9533. OIL FEEDERS for LUBRICATING MACHINERY, W. Child, Birmingham.
9534. BOOT TOE PROTECTOR, W. Atkinson, Bradford.
9535. AUTOMATIC SHIP BERTHS, J. B. Secor, London.
9536. SCORE and other REGISTERS, D. B. Morison, Hartlepool.
9537. MAKING METAL PIPES, &c., W. P. Thompson.—(*C. Kellogg, United States.*)
9538. FIRE SCREENS, W. Rogers, Liverpool.
9539. SCRAPING TRAMWAY LINES, S. Strange and J. Whitehead, Liverpool.
9540. SCREW PROPELLERS, B. Dickinson, London.
9541. CENTRE VALVES for GAS PURIFIERS, R. Demster, jun., Manchester.
9542. COMPOUND DRIVING GEARING for MACHINERY, W. W. Hulse, London.
9543. DIRECT CONDUCTION of GAS FLAME HEAT to HYDROCARBON, H. E. A. Wallis and H. T. Ratcliff, London.
9544. ELECTRICAL SIGNALLING LAMP, &c., E. G. Craven, London.
9545. METALLIC CHAINS and FABRICS, A. M. Clark.—(*W. C. Edge, United States.*)
9546. REGULATING the FLAMES in GAS BURNERS, G. Downing.—(*R. Saalfeld, Germany.*)
9547. PREVENTING SHIPS ROLLING, J. Appleyard and J. Johnson, London.
9548. BRAKE BLOCKS, J. Nicholl, Halifax.
9549. AUTOMATIC VENT PEG, E. Payne and E. L. Sheldon, London.
9550. WOOL WASHING MACHINES, W. E. Gedge.—(*H. C. Walker, United States.*)
9551. PREVENTING SMOKE in FURNACES, &c., W. Gunn.—(*The Coal Economising Company, United States.*)
9552. BEER and LIQUOR TAP, H. W. Sparke, London.
9553. CLASPS for GARTERS, &c., W. H. Palmer and J. C. W. Jefferys, London.
9554. SKIRTS and PANIERS, C. C. Carpenter and G. W. Lockwood, London.
9555. COUNTERS for PRINTING PRESSES, &c., H. J. Haddan.—(*C. T. Brown, United States.*)
9556. PREPARING the CHARGE for ZINC FURNACES, H. J. Haddan.—(*E. Phillips and T. Jones, U.S.*)
9557. KEYLESS STRETCHERS, J. L. Rawbone, London.
9558. CHAFF SIFTERS, F. Jewell, London.
9559. MALT STIRRING MACHINES, B. J. B. Mills.—(*A. J. Reynolds, United States.*)
9560. SOAKING, BRUSHING, and DRAINING BOTTLES, C. T. Gibbings, London.
9561. VENTILATING BRICK, A. Wilkinson, London.
9562. BURNERS for HYDROCARBON OILS, F. Plaister and G. S. Symmons, London.
9563. GALVANIC BANDS and PLATES, D. B. Macqueen and H. Wilkie, Glasgow.
9564. ELECTRICAL SYNCHRONOUS MOVEMENTS, A. L. Parcelle, London.
9565. MECHANICAL MOTORS, A. F. Martel, London.
9566. AUTOMATIC RAILROAD GATES, J. J. Murray, jun., London.
9567. ADJUSTABLE OFFICE TABLE or DESK, A. M. Clark.—(*W. Weishaupt, Germany.*)
9568. UTILISING the DEFLECTION of a RAIL, &c., C. D. Abel.—(*Siemens and Halske, Germany.*)
9569. CONTROLLING SIGNALLING APPARATUS, &c., E. J. Houghton, London.
9570. GENERATING CURRENTS of VOLTAIC ELECTRICITY, R. H. Courtenay, London.
9571. PRINTING MACHINES, H. P. Feister, Philadelphia, United States.
9572. HOLDING WEBS of TOILET PAPER, H. H. Lake.—(*S. Wheeler, United States.*)
9573. LETTER-COPYING BOOKS, W. Howard, London.
9574. RICE HULLING MACHINE, E. C. Engelberg, London.
9575. SUBSTITUTE for GLASS, W. B. Woodbury and F. Vergara, London.
9576. CORKING BOTTLES, E. Edwards.—(*H. Soyez, Belgium.*)
9577. LOCKS, W. L. Wise.—(*J. Lederer, Austria.*)

12th August, 1885.

9578. DECORATING GLASS, J. Northwood, Kingswinford.
9579. REMOVING BUTTER and other GOODS from FIRKINS, &c., J. Dundon, Limerick.
9580. INSULATING COMPOUNDS, A. Muirhead and C. R. A. Wright, London.
9581. FASTENING BUTTONS, &c., on to CLOTHING, G. H. Herbert and S. E. Jackson, Oldham.
9582. GEARING, J. H. Adamson, London.
9583. SPINNING and DOUBLING COTTON, &c., J. Seed, Manchester.
9584. ADJUSTABLE CLIMAX DOOR SPRING, J. Cartland, Birmingham.
9585. NAVIGATING the AIR, W. H. Prestwich, London.
9586. NAVIGATING or PROPELLING BOATS or VESSELS, W. H. Prestwich, London.
9587. ALARM GUNS, A. Farquharson, London.
9588. VENTILATOR SASH FASTENER and WINDOW PROTECTOR, E. F. Haynes and T. F. Ford, Birmingham, and J. Keatley, Aston.
9589. GRINDING and POLISHING MACHINES, R. Luke and M. Spencer, London.
9590. DETENT for SPINNING FRAMES, R. N. Cottrill, Manchester.
9591. PREPARING FUEL for SMELTING PURPOSES, J. McCulloch and W. Black, Glasgow.
9592. SPIRAL CURTAIN CHAIN or BAND, J. Empson and J. Hewitt, Birmingham.
9593. SHEDDING MOTIONS, O. Ball, Bradford.
9594. PORTABLE BEDSTEADS, W. P. Thompson.—(*J. B. Fondu, Belgium.*)
9595. HAULING APPARATUS, C. J. Merton, Newcastle-upon-Tyne.
9596. MINERS' SAFETY LAMP, J. Douglas, London.
9597. TICKET or CHECK, A. Jamieson, London.
9598. ROTARY MOTIVE POWER ENGINES, R. Morley, Liverpool.
9599. SPINNING and DOUBLING FRAMES, H. Ashworth and E. Eaves, London.
9600. VELOCIPEDES, W. Smith and G. Hicking, London.
9601. ELECTRO-MAGNETS, H. W. Ravenshaw, London.
9602. DISJOINABLE PAPER MILL, L. A. Groth.—(*F. Kurtz, Germany.*)
9603. PREPARING ELASTIC LEATHER, &c., L. A. Groth.—(*F. W. Grüne, Germany.*)
9604. BOATBUILDING, S. E. Saunders, London.
9605. TOYS, E. Staudigel, London.
9606. ATTACHMENTS for the STRINGS of PIANOS, &c., H. J. Haddan.—(*A. Uhlig, Saxony.*)
9607. MOUNTINGS for ROLLERS of WINDOW BLINDS, T. M. Glen, Glasgow.
9608. BAGS or ENVELOPES, J. Tomlinson, London.
9609. TINS, &c., F. W. Feaver and J. Feaver, London.
9610. TESSERAE and MOSAICS, F. Gibbons, London.
9611. WATER TUYERES, B. Fenton, C. Fenton, and W. B. Fenton, London.
9612. ICE, C. D. Abel.—(*C. Linde, Germany.*)
9613. STEAM ENGINE and BOILER, H. Kottgen, London.
9614. TREATMENT of WASTE ACIDS, A. A. Vale.—(*The Chemische Fabriks Actien Gesellschaft, Germany.*)
9615. HAND FIRE EXTINGUISHER, H. Gardner.—(*R. A. Saalfeld, United States.*)
9616. ATTACHING LACING HOOKS to BOOTS and SHOES, H. H. Lake.—(*E. H. Train, United States.*)
9617. DUST-BINS, J. C. Morrell, Ealing.
9618. CONVEYING AWAY REFUSE from STREETS, &c., W March, London.

13th August, 1885.

9619. BALLOONS and their CARS, W. Howard, London.
9620. SEASONING TIMBER, R. W. Taynton, London.
9621. CHIMNEY TOPS and VENTILATORS, J. A. Macmeikan, London.
9622. TROUSER STRETCHER, F. R. Baker, Birmingham.
9623. ACTINOMETERS for PHOTOGRAPHIC PURPOSES, A. C. Farnsworth, Manchester.
9624. PROPELLING MECHANISM by CONDENSED ATMOSPHERIC PRESSURE, G. H. O. Hamerton, Hammersmith.
9625. SECURING HANDLES to the SPINDLES of LOCKS, J. Kenyon, Manchester.
9626. DRUM WINDING FRAMES, B. A. Dobson and J. Hill, Manchester.
9627. COUPLING and UNCOUPLING RAILWAY VEHICLES, J. Simpson, Manchester.
9628. HANGERS for STOVES and GRATES, J. Carpenter, Southampton.
9629. POCKET COOKING STOVE and KETTLE COMBINED, E. Brennan, Liverpool.
9630. DUPLEX TEA or COFFEE POT, H. Tipper, Birmingham.
9631. LACES, A. P. Sharp, Dublin.
9632. REVOLVING PURSE without a SNAP or ELASTIC, W. J. Phillipson, Bentham.
9633. LUBRICATING BRICK DIE, F. Boyes, East Hartlepool.
9634. TORPEDO NETS, D. B. Morison and H. Cheesman, Hartlepool.
9635. JACK RACK, S. Bott and R. W. Cooke, Birmingham.
9636. RAILWAY CHAIR, W. B. Carr, Farnham.
9637. AUTOMATIC MECHANICAL FOG SIGNALLING APPARATUS for RAILWAYS, C. J. Garnet and W. Black, Keighley.
9638. BUSTS for FITTING ARTICLES of DRESS, &c., F. McIlvenna and W. Thompson, Liverpool.
9639. BALL BEARING CASTORS, J. R. Hargrove, Sparkbrook.
9640. APPARATUS for STARTING TRAMCARS, &c., S. Bourne.—(*T. F. Bourne, United States.*)
9641. REVOLVING TARGETS for RIFLE SHOOTING, A. L. Winser, Brighton.
9642. COOKING STOVES, J. Twyerould, Manchester.
9643. TARPAULIN FASTENER, J. Knox, Durham.
9644. PULLEYS and WHEELS, J. J. Lane, London.
9645. DOMESTIC TELEPHONES, G. Trier.—(*C. Mildé France.*)
9646. UTILISING ALCOHOL and ACETIC ACID, G. Krüger London.
9647. AZIOMETER, R. E. Harris, Portland.
9648. FASTENINGS for BOOTS, &c., J. W. Hayward, Newfoundland.
9649. HOLDER for HAND TOOLS, J. G. Fischer, London.
9650. CONSTRUCTION of CARBURETTING APPARATUS, H. E. A. Wallis and H. T. Ratcliff, London.
9651. APPARATUS for ADVERTISING, J. C. Sellars, Liverpool.
9652. HATS and BONNETS, E. C. Vickers, London.
9653. BRAKING or SAFETY APPARATUS for HOISTS, R. A. Beaver, Liverpool.
9654. TELEPHONIC CHECK APPARATUS for PUBLIC CALL-BOXES, D. Sinclair, Glasgow.
9655. ELECTRICAL SWITCH, N. G. Thomson, London.
9656. APPARATUS for SHAPING MACHINE WORK, &c., W. M. Smith, London.
9657. SELF-LUBRICATING PISTON, J. Mayer, London.
9658. CONSTRUCTION of VALVES, T. A. Wheatley, London.
9659. CHECKING APPARATUS, P. Everitt, London.
9660. TREATING LEATHER ARTICLES, &c., T. N. Ashman, London.
9661. PHOTOGRAPHIC APPARATUS, J. Y. Johnson.—(*F. H. Mader, Germany.*)
9662. SAFES, D. R. Ratcliff, London.
9663. BODKIN, S. H. Langton, London.
9664. SEWER or DRAIN TRAPS, F. Iles, London.
9665. MACHINERY for the MANUFACTURE of SCREW RIVETS, G. Bell and W. Juxon, London.
9666. ELECTRIC ARC LAMPS, E. C. Street and F. V Maquaire, London.
9667. CONSTRUCTION of GAS LAMPS, D. W. Sugg, London
9668. APPARATUS for REMOVING BURS from WOOL, C. D. Abel.—(*La Société Harmel, frères, France.*)
9669. CIRCULAR COMBS, C. D. Abel.—(*J. Imray, Germany.*)
9670. TRICYCLES, &c., W. A. Large, London.
9671. AXLE-BOXES, H. K. Austin, London.
9672. RANGE FINDERS, T. Nordenfelt, London.
9673. SOAP MAKING, C. Rumble and F. Sear, London
9674. MARINERS' COMPASSES, J. Sandeman, London.

14th August, 1885.

9675. HANGERS, BEARINGS, &c., for SHAFTS, H. Smith, London.
9676. SCOURING and WASHING WOOL, &c., J. and W McNaught, London.
9677. ADITS and WATER-WAYS, G. Anderson, Glasgow.
9678. LOADING CARTRIDGES, W. Ford, Birmingham.
9679. GAS RETORTS, H. J. Rogers, Watford.
9680. DOUBLE TAPESTRY and UPHOLSTERY NAIL, E. F. Haynes and T. F. Ford, Birmingham.
9681. PROPELLING and STEERING SHIPS, &c., J. Ellis Halifax.
9682. OILCANS, W. Fitton and A. Gillespie, Oldham.
9683. TREATING, SEPARATING, or MIXING FLOUR, &c. W. H. Williamson, Wakefield.
9684. FILTERING TAP, R. Evans, Newcastle-on-Tyne.
9685. LOCK-UP BOTTLE STANDS, H. T. Brockwel London.
9686. FASTENING BUTTONED BOOTS and SHOES, J. Radcliffe, Hulme.
9687. PRESSING and MOULDING BUTTER, J. Maude, Halifax.
9688. DRIVING GEAR for DYNAMOS, H. Lindley, London.
9689. REGULATING the FEED of MATERIAL to MILLING, &c., MACHINERY, J. and J. B. Holgate, London.
9690. WASHING, &c., FIBROUS MATERIALS, T. Salt and W. Stead.—(*F. Pasquay, Germany.*)
9691. STEEL PENS, P. C. Jones, Guildford.
9692. PEN, PENCIL, and MEMORANDUM COMBINED, C. Q. Brugia, London.
9693. PUFFS for BOOTS and SHOES, F. Squire, London.
9694. RECOVERING the EXCESS of SULPHURIC ANHYDRIDE from DYES, &c., G. M. S. Horton.—(*Root and Tinker, United States.*)
9695. LOWER FRAMES of LAMPS and LANTERNS, T. Heron, London.
9696. TRANSPORTING CASH or PARCELS, B. J. B. Mills.—(*R. A. McCarthy, United States.*)
9697. CAR COUPLINGS, L. Schwarz Glasgow.
9698. GAS and OIL LAMPS, H. H. Dott, London.
9699. ALTISCOPE, J. Bogle, Glasgow.
9700. KETTLES, &c., C. Bellamy and P. G. Fletcher, London.
9701. SELF-IGNITING and INEXTINGUISHABLE SIGNAL LIGHTS, N. J. Holmes, Sevenoaks.
9702. SELF-CLOSING MATCH, &c., BOXES, D. J. Williams, London.
9703. SLIDING WINDOW SASHES, W. Youlten, London.
9704. CORRUGATED FLUES and SHELLS of BOILERS, J. D. Morrison and J. Robson, London.
9705. SHIPS' SAILS, H. H. Lake.—(*G. Bianchi, Italy.*)
9706. PRODUCING INDUCED ELECTRIC CURRENTS, C. D. Abel.—(*J. C. Pürthner, Austria.*)

15th August, 1885.

9707. WATER SUPPLY APPARATUS for WATER-CLOSETS A. Allan, Glasgow.
9708. LAMPS, H. J. Allison.—(*C. S. Upton, U.S.*)
9709. SPINNING and other BEARINGS, T. H. Briggs, Bradford.
9710. BUTTON, W. Kilsby and J. M. Griffith, London.
9711. FOUR-WHEELED CARRIAGES, M. and D. Easton, Portsmouth.
9712. COATS and WAISTCOATS, R. J. Spink, Oswestry.
9713. GAS MOTOR ENGINES, G. Whittaker, Manchester

9714. Bed Bath, F. Marsden, London.
9715. Tobacco Pipe, G. H. K. Fuller, Liverpool.
9716. Drains and Drainage Traps, B. R. Phillipson, Dublin.
9717. Pulley for Blind Cords, F. W. Micklewright, London.
9718. Variable Cut-off Gear, J. Beveridge, London.
9719. Adjusting Window Blinds, G. H. Wilson and R. B. Breidenbach, London.
9720. Generation of Gas, B. Andreae, Halifax.
9721. Fire-grates, J. Platt, Sheffield.
9722. Operating Clearers in Spinning, &c., Machinery, R. Hadfield and J. W. Pickering, London.
9723. Adjustable Chairs, G. H. Loveland, London.
9724. Lubricating Journals of Railway Carriages, J. McGill, Ayr.
9725. Economising Coal, &c., R. W. Anderson, Liverpool.
9726. Closing Vessels, A. Browne.—(*L. Mocznik, Hungary.*)
9727. Packing for Pistons, &c., W. Laing, London.
9728. Slide Valve, A. Fergusson, London.
9729. Lock Nuts, J. J. Claret, Rochdale.
9730. Compounds for the Manufacture of Furnace Bricks, W. O. Wood, London.
9731. Apparatus for the Manufacture of Artificial Fuel, W. B. Westlake, London.
9732. Syphon Water Traps, D. Tennant, Glasgow.
9733. Bottles for Measuring Liquids by Drops, C. D. Abel.—(*A. A. Jannin, France.*)
9734. Railway Chair, W. Walker, London.
9735. Feed-lubricator, H. J. Allison.—(*J. S. Hall, United States.*)
9736. Electical Apparatus for Unfastening Doors, W. H. Beck.—(*G. Godde and H. Grégoire, jun., France.*)
9737. Stretchers, J. Moore and J. M. Montgomery, London.
9738. Cowls, W. Gordon. London.
9739. Knitting Machines, J. T. Anderson and J. Berry, Glasgow.
9740. Moustache Protector and Cigar Holder, W. J. C. Lund, London.
9741. Devices for Telegraphic Purposes, A. M. Rosebrugh, London.
9742. Tags, C. F. Webster and E. B. Southworth, London.
9743. Force Pumps, M. Guggenheim.—(*G. Allweiler, Germany.*)
9744. Application of Heat to Generating Steam, M. P. W. Boulton, London.

17*th August*, 1885.

9745. Ventilating Boots or Shoes, G. H. Winscom, Newport.
9746. Watch Protector, G. W. and T. Harding, Birmingham.
9747. Copy Holder, J. Deakin, Birmingham.
9748. Mattresses and Frames, I. Chorlton and G. L. Scott, Manchester.
9749. Closing Slide for Bakers' Ovens, W. P. Thompson.—(*A. Nestlen, Germany.*)
9750. Closing Tap Hole in Casks, J. Wilkes, Handsworth.
9751. Hats, J. W. Thompson, Manchester.
9752. Boots and Shoes, W. Freeman, Leicester.
9753. Metal Fittings for Boots, W. Morris, London.
9754. Needles, T. O. Johnson, Birmingham.
9755. Electric Connections to Clocks, A. Pohlman, Halifax.
9756. Fastenings for Windows, J. Ostins, London.
9757. Flower-pots, R. G. Owen, London.
9758. Purifying, &c., Liquids, H. J. Haddan.—(*A. Z., N. G. A., and L. P. G. Champy, Belgium.*)
9759. Grinding Grain, I. Watkin, Liverpool.
9760. Shaping Articles of Wood, &c., C. Ryan, Glasgow.
9761. Gas Producers, J. J. Barclay and J. Thompson, London.
9762. Portable Electric Lamps, J. E. Liardet, London.
9763. Machine for the Manufacture of Socks, G. F Redfern.—(*S. Pagny, France.*)
9764. Metallic Screw Bung for Casks, &c., R. Gregory and T. Busby, London.
9765. Cut Nails and Cut Nail Machines, J. W. and J. L. Heward, London.
9766. Brake Mechanism for Hoisting Apparatus, G. Mehlis, London.
9767. Ball Bib and other Valves, A. Priest, Lewisham.
6768. Flower-holders, A. Kershaw, Halifax.

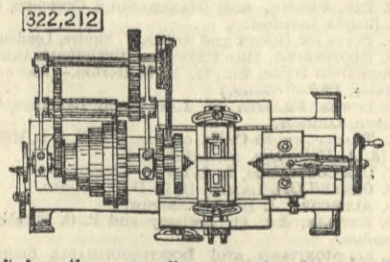
SELECTED AMERICAN PATENTS.

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

322,212. Lathe for Turning Crosshead Pins, *Nicholas Thomas, Chicago, Ill.—Filed May 22nd*, 1885.

Claim.—(1) The combination of a lathe spindle, a crank shaft fitted to rotate in bearings in the head-stock or supporting head of said spindle, and an intermediate connection whereby vibratory movement is imparted to the spindle from the crank shaft, substantially as and for the purpose set forth. (2) The combination of a lathe spindle, a crank shaft mounted on the head-stock or supporting head of said spindle, a gear adapted to vibrate about an axis on the head-stock, a connecting-rod coupled to a pin on the crank shaft and to said gear, and a pinion secured upon the spindle and meshing with said gear, substantially as set forth. (3) The combination of a lathe spindle, a cone pulley fitting freely thereon, a crank shaft mounted in bearings in the head-stock or supporting head of a spindle, gearing for rotating said shaft from the cone pulley, a gear adapted to vibrate about an axis on the head-stock, a connecting-rod coupled to a pin on the crank shaft and to said gear, and a pinion secured upon the spindle and meshing with said gear, substantially as set forth. (4) The combination of a lathe spindle, a cone pulley fitting freely thereon, a back gear shaft and a supplemental crank shaft, each mounted in bearings on the head-stock or supporting head of the spindle, gearing for rotating the back gear

322,212

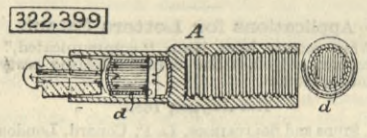


shaft from the cone pulley, a pinion fitted to slide longitudinally on the back gear shaft and to engage either a gear on the crank shaft or a gear fixed upon the spindle, a gear adapted to vibrate about an axis on the head-stock, a connecting-rod coupled to a pin on the crank shaft and to said gear, and a pinion secured upon the spindle and meshing with said gear, substantially as set forth. (5) The combination of a lathe spindle, a lathe carriage or saddle, two tools or cutters, each mounted in an independent slide block on the carriage, two feed screws, each governing the movement of one of said slide blocks toward and from the centre line of the spindle, and two pinions, each mounted upon one of said feed screws, either of said pinions being fitted to slide longitudinally upon its feed screw, so that said pinions may be engaged or disengaged to enable either coincident or independent movement of the slide blocks and tools to be effected, substantially as set forth.

322,399. Gas-burner, *Orren M. Smith, Philadelphia, Pa.—Filed September 25th*, 1883.

Claim.—A gas-burner consisting of an outer shell having inlet and outlet openings at opposite ends, and provided with a flat centrally perforated diaphragm to direct the current upward, and an inverted mixing

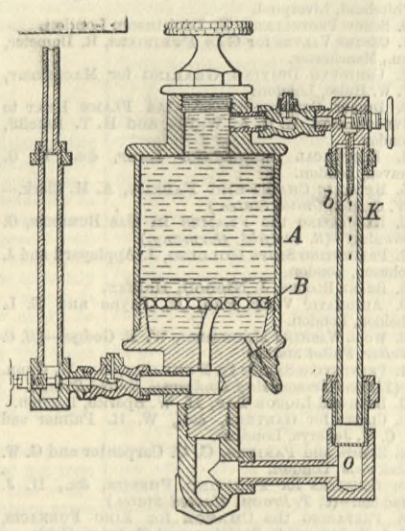
322,399



cup permanently fixed above the same, together with the exit slots or corrugations *d*, substantially as described.

322,407. Lubricator, *Peter Barclay, Boston, Mass.—Filed December 3rd*, 1884.

Claim.—(1) In a steam pressure engine lubricator constructed to operate by drop feed, and in which the oil in the cup is indirectly discharged by water of condensation derived from the steam, the combination, with the oil-cup having an oil discharge outlet at or near its top, of the lower perforated steam condensing coil, and an inlet for the steam to said coil, substantially as specified. (2) In a steam pressure engine lubricator constructed to operate by a downward drop

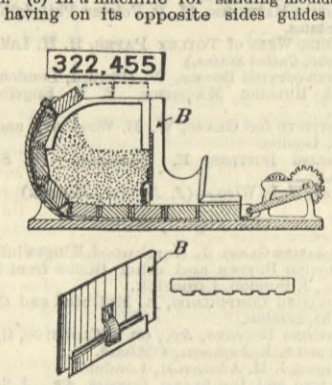


feed, substantially as described, the combination, with the glass or glazed indicator tube, of a perforated diaphragm arranged near or below the lower end of said tube, essentially as and for the purpose herein set forth. (3) The combination of the feed nozzle *b* with the indicator tube K, and the perforated diaphragm O, arranged near or below said tube, essentially as described. (4) The combination, with the lubricator cup A, of the steam condensing perforated coil B, having a lower central tubular extension forming a support and inlet to the coil, and an outer closed end, substantially as shown and described.

322,455. Machine for Sanding Brick Moulds, *Roswell S. Judson and Cyrus J. Hancock, Matteawan, N.Y.—Filed November 13th*, 1884.

Claim.—(1) In a machine for sanding moulds, a sand-box having a front board B, and provided near its lower forward end with an inlet opening, substantially as set forth. (2) In a machine for sanding moulds, a box having an inlet opening, fitted to permit the insertion of the moulds and provided with a valve controlling said opening, substantially as set forth. (3) In a machine for sanding moulds, a sand-box having on its opposite sides guides fitted to

322,455

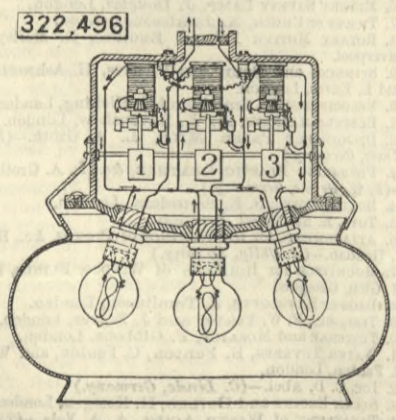


receive the ends of the moulds, and adapted to guide said moulds upward and invert them over the box, substantially as set forth. (4) In a machine for sanding moulds, a box formed with inlet and outlet openings, and having guides on its opposite sides fitted to receive the ends of the moulds, and provided on its bottom with rails, substantially as set forth. (5) In a machine for sanding moulds, the box herein described, having an inlet opening controlled by a suitable valve and provided with rails fitted to support the moulds, and provided with guides adapted to direct the moulds upward and invert them over the box, substantially as set forth.

322,496. Multiple Incandescent Electric Lamp, *William Stanley, jun., Pittsburg, Pa.—Filed July 11th*, 1884.

Claim.—The combination, substantially as hereinbefore set forth, with a group of incandescent electric lamps, of an electric conductor normally connected through one of said lamps, normally interrupted branch circuits in which the remaining lamps of said group are respectively included, a shunt circuit

322,496

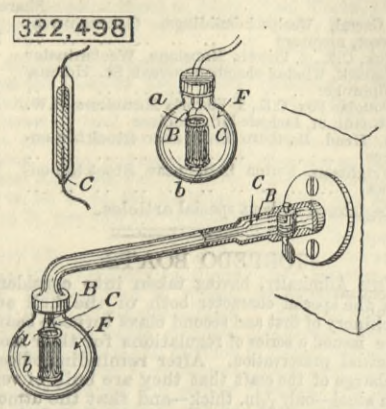


around each of said lamps, and an electro-magnet included in each of said shunt circuits, and a circuit-closing device, under the control of each of said electro-magnets, which serves to complete the connections of said main line conductor through a succeeding lamp in said group when a preceding lamp becomes inoperative.

322,498. Incandescent Electric Lamp, *Philip K. Stern, Toronto, Ontario, Canada.—Filed November 15th*, 1884.

Claim.—(1) An electric lamp composed of a filament or pencil connected to a suitable source of electricity and embedded in solid glass surrounding and touching it at all points, in combination with a hermetically sealed tube or globe surrounding the same to form a closed air chamber enclosing the whole, whereby the pressure of the air contained between said glass and

322,498

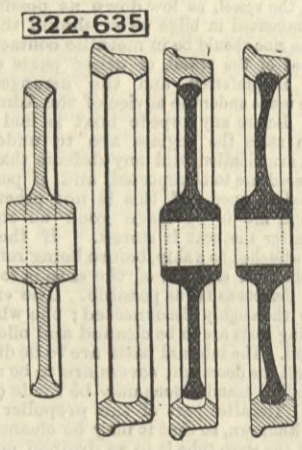


globe serves to compress the solid or inner glass upon the filament or pencil, substantially as described. (2) In an electric lamp, the globe F, the wires B C, the rings *a b*, suspended within said globe by said wires, and two or more lamps supported by said rings and connected with said wires, substantially as described.

322,635. Method of Making Car Wheels, *Wilhelm Pelz, Essen, Germany.—Filed March 9th*, 1885.

Claim.—(1) The method herein specified of manufacturing car wheels, consisting in forming the malleable rim with a recessed or interlocking inner surface, and the malleable middle disc part or spokes with outward projections, and then bringing the two parts to welding heat and placing them in suitable dies, and then by blows or pressure expanding the

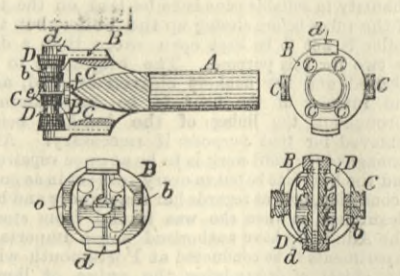
322,635



middle disc part or spokes, so that the same is made to interlock with the inner surface of the rim, substantially as set forth. (2) The method herein specified of manufacturing car wheels, consisting in forming the rim with a recessed inner surface and the spokes or disc separately out of malleable metal, and then spreading the metal of the disc or arms into the recessed inner surface of the rim and welding the parts together, substantially as specified.

322,642. Rock Drill, *Isaac Reese, Nashville, Tenn.—Filed March 23rd*, 1885.

Claim.—In a rock or coal drill, the combination, with a shaft A, having a chambered cylindrical head B, provided with a central wedge-shaped bearing *e*, side bearings *b d*, and interior bevelled ridges *f*, leading to outwardly-curved longitudinal perforations *c*, of the

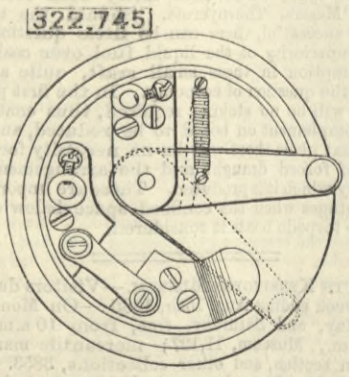


cylindrical cutting rollers C C, journalled in opposite bearings on the outer surface of the drill head, and the conical rollers D, journalled centrally in the head of the drill, substantially as shown and described.

322,745. Electric Switch, *Edmund B. Nicolaus, Cleveland, Ohio.—Filed January 6th*, 1885.

Claim.—(1) In an electric switch, the combination, with the two terminals, of a switch lever pivotted to one terminal and constructed and arranged to make a sliding frictional contact with the other terminal, and a retractile spring secured at one end to the switch lever and at its opposite end to a fixed support, and arranged to have a tendency at all times to disrupt the contact and throw the switch lever to its open position, substantially as set forth. (2) In an electric switch, the combination, with the two terminals and

322,745

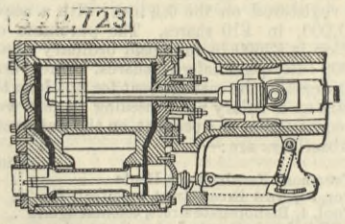


a fusible strip interposed in the circuit, of a switch lever pivotted to one terminal and constructed and arranged to make a sliding frictional contact with the other terminal, and a retractile spring connected at one end to the switch lever and at its opposite end to a fixed support, and arranged to have a tendency at all times to disrupt the contact and throw the switch lever into its open position, substantially as set forth.

322,723. Valve Indicator, *Albert L. Ide, Springfield, Ill.—Filed February 18th*, 1885.

Claim.—(1) The combination, with the steam valve of a steam engine, of an indicator operated by the movement of the valve, and constructed to show the number of inches of steam in the cylinder at the moment the steam supply is cut off, substantially as described. (2) The combination, with the steam valve of a steam engine, of an indicator showing the number of inches of steam in the cylinder at the time

322,723

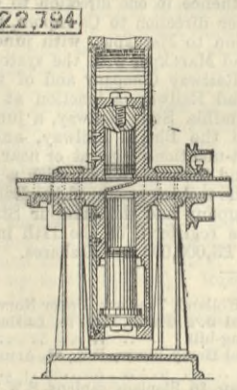


the steam supply is cut off, comprising a pointer or index hand operated by the movement of the valve, and a stationary scale or dial having a central blank space showing the extent of the valve lap, and graduated parts at either side of the blank space indicating the number of inches of steam in the cylinder at the moment the steam is cut off, substantially as described. (3) The combination, with the steam valve and excentric rod of a steam engine, of a rock shaft for transmitting motion from the said excentric rod to the valve provided with an index hand and a stationary dial, substantially as and for the purpose set forth.

322,794. Motor, *John W. Cloud and Axel Vogt, Altona, Pa.—Filed December 9th*, 1884.

Claim.—In a fluid pressure motor, a casing or wheel mounted upon a tubular axis, and a tubular valve, which does not rotate, passing through the tubular axis, and having a partition plate and supply and

322,794

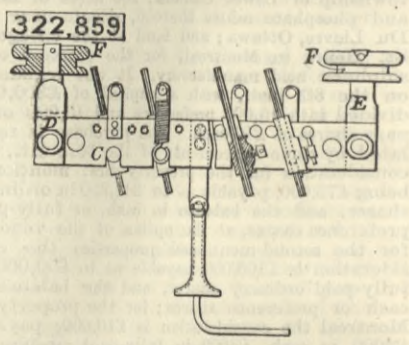


exhaust ports, combined with cylinders within the casing, each provided with a weighted piston and a port adapted to communicate, at the proper time or times, with the supply and exhaust ports of the tubular valve during the rotation of the casing or wheel around its axis substantially as set forth.

322,859. Electric Railway, *Ernst W. Siemens, Berlin, Germany.—Filed April 8th*, 1885.

Claim.—(1) The combination of the suspended rail, the contact truck having brushes that press against the under surface of the conducting rail, and the pendent socket having a flexible conductor leading to the railway carriage. (2) In an electric railway, the combination of a conducting rail with a smooth under surface for the contact brushes, connected with a stationary dynamo-electric machine, and an insulator, from which the conducting rail is suspended. (3) The contact truck consisting of two side cheeks C C, con-

322,859

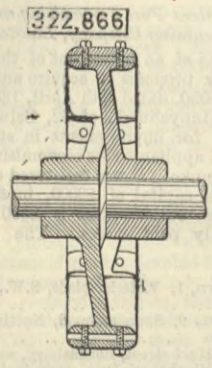


nected by bolts D and uprights E, provided with grooved rollers F, as and for the purposes described. (4) The combination of the contact truck having sockets G and stop pins *o*, with brushes adjusted by clamping screws, as and for the purposes described. The combination of the contact plates a^1 b^1 c^1 d^1 e^1, connected, respectively, with the contact plates *a b c d e*, the contact lever N, which on being moved to the same angle of resistance on either side of its contact position makes the same contact, and the contact truck having reversible brushes electrically connected to the contact lever.

322,866. Shaft Coupling, *Harris Tabor, New York, N. Y.—Filed June 18th*, 1885.

Claim.—(1) The combination of two lines or sections of shafting, and a flexible strip or band secured by intermediate connections at different points in its length to one and the other of said lines alternately, substantially as set forth. (2) The combination of two coupling heads or bearers, each secured to a line or section of shafting, and a flexible strip or band

322,866



secured peripherally to one and the other of said coupling heads alternately, at points separated by spaces over which the flexible band passes freely, substantially as set forth. (3) The combination of two coupling heads or bearers, each secured upon a line or section of shafting, and having a series of outer bearing faces, said bearing faces being fixed alternately to one and to the other coupling head, and a flexible strip or band passing over said bearing faces and secured thereto, substantially as set forth.