SHARP, STEWART, AND CO.'S PLANING MACHINE.

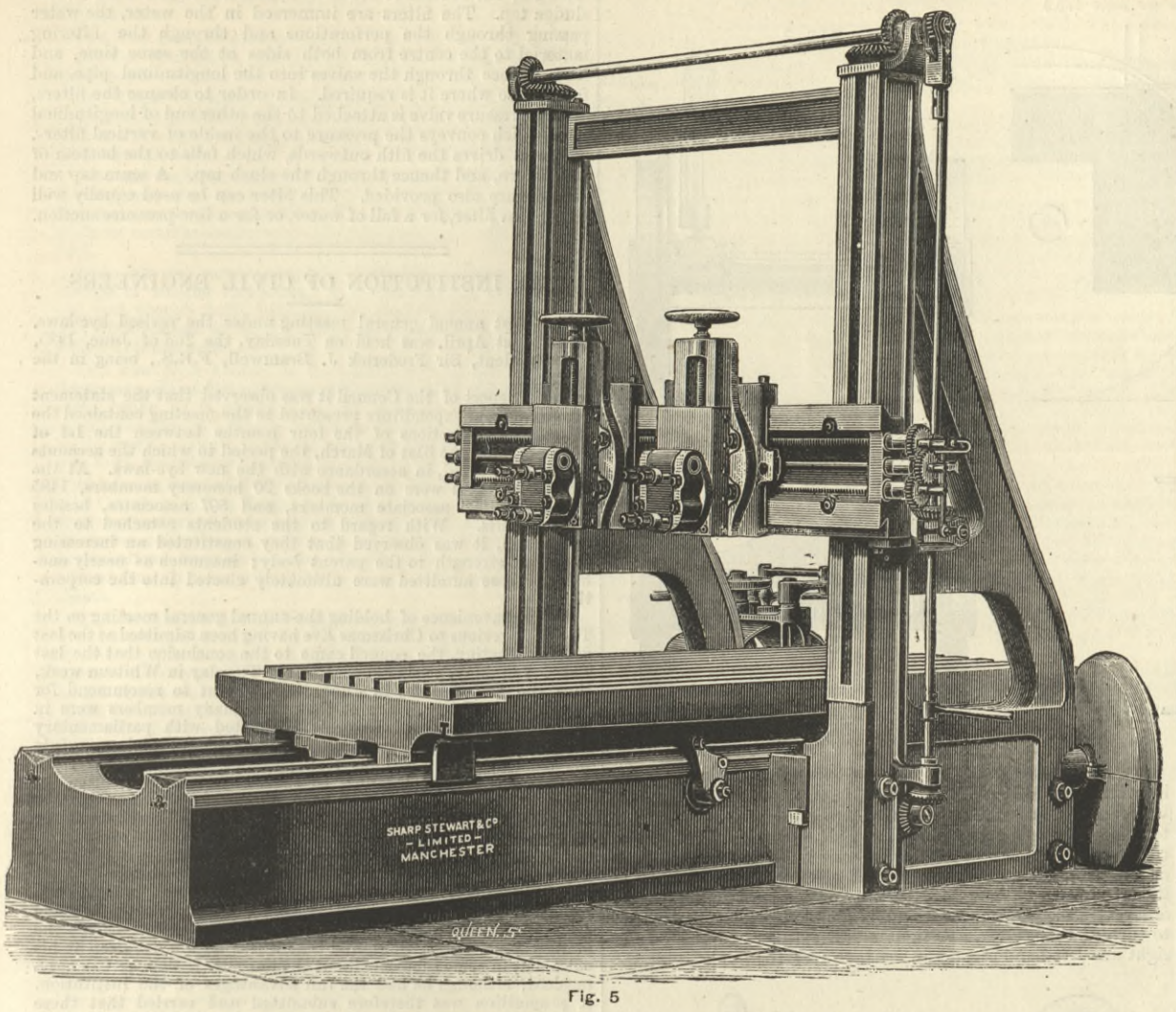


Fig. 5

MACHINERY IN THE INVENTIONS EXHIBITION.

MESSRS. SHARP, STEWART, AND Co., of the Atlas Works, Manchester, are exhibitors in Groups 4 and 10. In the former they show a model of Bottomley's radial axle-box and a collection of injectors. The object in designing the former has been to produce a simple and cheap form of radial axle-box, dispensing with curved guides, and at the same time to provide for flexibility and to ensure that the axle shall assume a truly radial position upon any curve. The ordinary arrangement is shown in Figs. 1, 2, 3, and 4, page 474; the two axle bearings are contained in one box, free to radiate from the centre pin by means of radius bars, no guides at all being used; the lateral motion is controlled by spiral springs, which are set in place with a considerable initial compression, and are so arranged that on leaving the central position the axle-box meets the full resistance of one or other of the springs. The extent of the side movement is limited by stops. At the hind end the bearing springs are placed, as shown in our illustrations, in the ordinary position, and their pillars rest upon large rubbing pieces, under which the axle-box is free to slide. At the front end an arrangement is introduced intended for very rough roads, the advantages in such a case of the American pony truck being gained by suspending the weight of the locomotive from a central point by means of a transverse spring, the lateral motion of the axle-box being in this case controlled by swing links instead of spiral springs. In either arrangement the axle-box is free to move in every direction, and cannot be jammed by any possible motion of the engine. The patent exhaust steam injector, of which Messrs. Sharp, Stewart, and Co. are the sole manufacturers in this country, finds a place among their exhibits. The other injectors exhibited by Messrs. Sharp, Stewart, and Co., are of their Atlas pattern, the original "removable nozzle" injector, which has many points of convenience from the ready access which can be had to the interior of the nozzles. The machine tools exhibited by Messrs. Sharp, Stewart, and Co. in Group 10 are well deserving of notice; the workmanship, design, and finish are of the highest class. The most important machine is the Sellers' planing machine—Fig. 5. Since Messrs. Sharp, Stewart, and Co. were appointed the makers of this machine under licence from Mr. Sellers, they have introduced some important improvements, and the machine as it now stands has advantages over any other type of planing machine. The peculiar way of driving the table, by means of a spiral pinion on a diagonal shaft gearing into a rack on the underside of the table, permits of the use of only two wheels instead of a train of gearing, and secures a smoothness of motion which allows of the machine being run at a much higher speed than is possible with either rack and pinion or screw machines. By using two straps—open and crossed—and special reversing and quick return gear, the slipping and "screeching" of the strap, unavoidable in ordinary machines, are obviated. Besides one of their portable key-way cutting machines, Messrs. Sharp, Stewart, and Co. exhibit a portable boiler drilling machine, of which we also give an illustration—Fig. 6. This machine, when in use, is suspended by the driving cord inside the boiler, thus occupying no shop space; it has two tools, which thrust from each other, and either or both of which can be stopped without stopping the machine. The machine can be used either for drilling holes out of the solid, or for opening out and making true holes previously punched or drilled to a smaller diameter than that of the rivet. The drills are fed up to the work by automatic gear, and both drills or only one may be worked at one time. The arrangement of the gearing for this purpose is clear from the engraving.

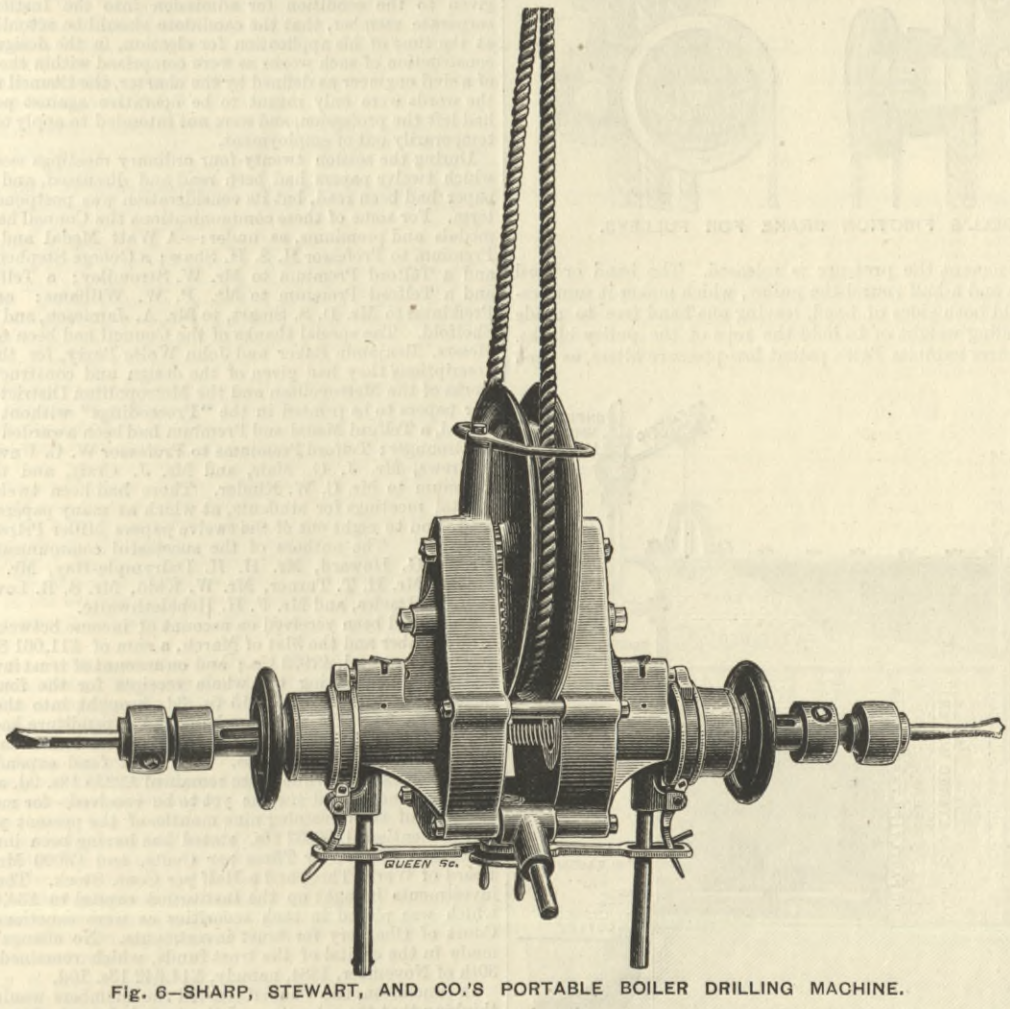
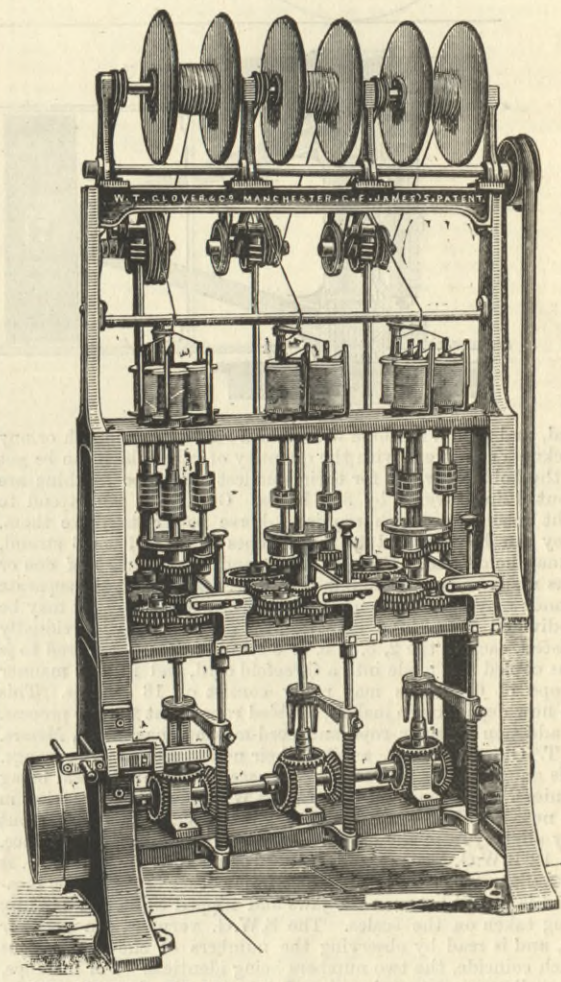


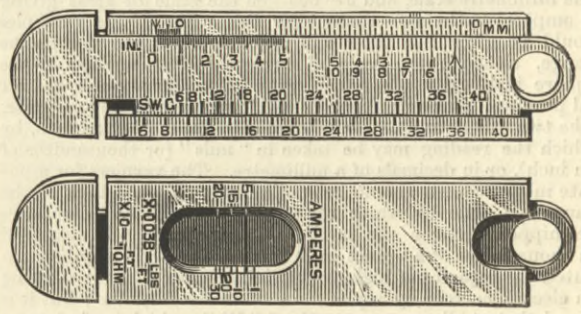
Fig. 6—SHARP, STEWART, AND CO.'S PORTABLE BOILER DRILLING MACHINE.

In the Western Gallery and Western Arcade, Messrs. Walter T. Glover and Co., of Salford, Manchester, exhibit machinery for cord, twine, and rope-making. The machines consist of one three-head small size "James" doubling and laying machine for silk, three machines for cord, and twine, &c., and three James' rope-making or cabling machines. The annexed engraving



JAMES'S DOUBLING AND LAYING MACHINE.

represents a three-head James' doubling and laying machine. To those acquainted with this class of machinery the engraving shows sufficiently the construction and working of this machine, which is for making all sorts of cord, as whipcord, spindle, and other banding, fishing line, Alma laces, hemp and jute twine, silk cord, worsted and bullion fringes, gold and silver thread. It will work any spun fibre, as linen, cotton, hemp, flax, jute, Manilla, silk, worsted, or asbestos. It is made in four sizes for the several purposes named. The small size

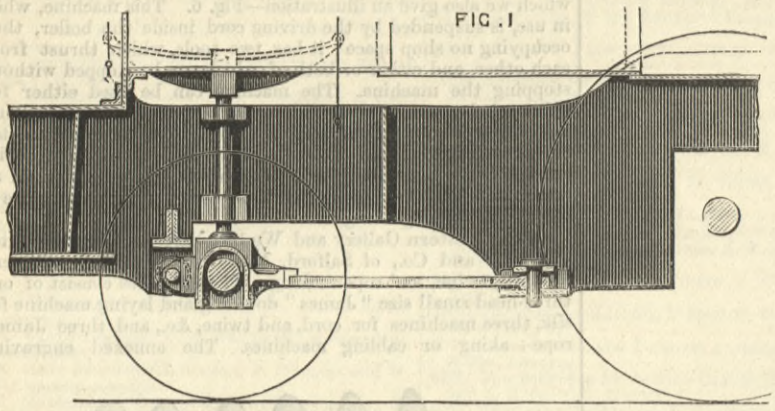


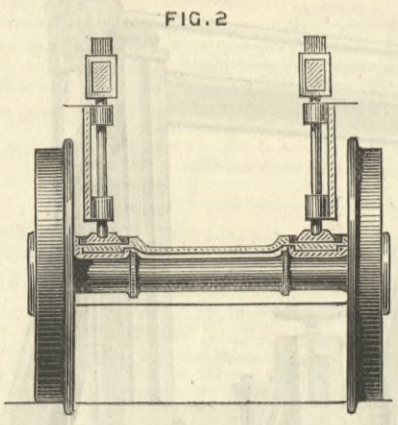
TROTTER'S WIRE GAUGE.

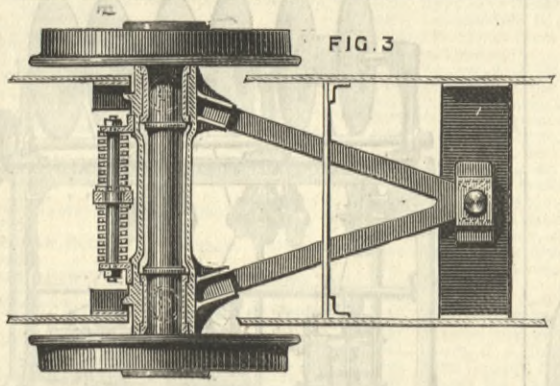
takes a bobbin 2¼in. by 1¼in., and the large size a bobbin 7½in. by 6in. On it cords can be made two, three, or four-strand, each strand consisting of one or many ends, as may be desired, and the machine puts the overtwist into the several strands and the undertwist into the finished cord simultaneously. These machines are made of three, six, twelve, or eighteen heads. Each head works independently of the other, so that on an eighteen-head machine eighteen different kinds of cord may be made at the same time. Each head is provided with an automatic stop motion, which stops the head as soon as an end breaks or begins to run loose or a bobbin runs empty; they thus require very little attention, and a girl can easily attend to from forty to sixty heads, according to the thickness of the cord. The cord is twisted regularly and may be made of any length; and by means of a drag which is put on the separate strands by means of weights hung on the spindles, all the stretch is taken out of the yarn before the strands are twisted, the tension being regulated according to the nature and size of the yarn by adding or removing the weights. The twist in the strands is regulated by means of change wheels, and in this way much or little twist may be secured. Each head can be arranged for either right or left-hand twist, and one head may be running right-hand at the same time that another is running left-hand way. Very little power is required, 1-horse power being sufficient for about thirty heads. The machine produces the most even cord at about one-fourth the cost of rope-walk work. The rope-making machines exhibited are very similar in principle to the James doubling and laying machine. They are, however, much heavier in construction, and specially adapted to making ropes. Messrs. Glover and Co. usually make them with one

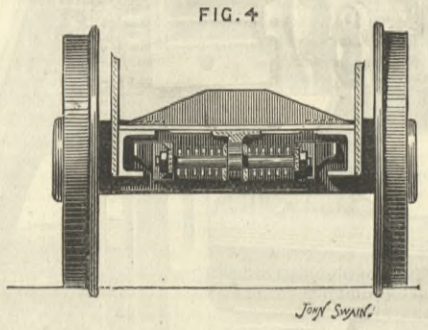
BOTTOMLEY'S RADIAL AXLE BOXES.

(*For description see page* 473.)



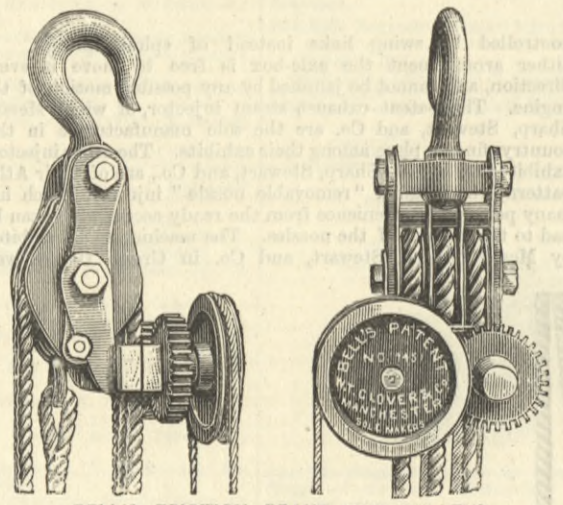






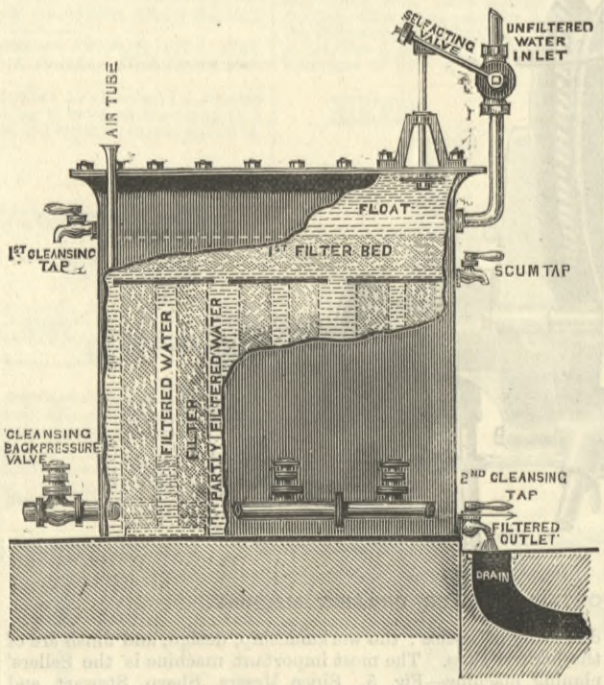
head, and such a machine will make a rope of any length or any thickness consistent with the quantity of yarn which can be got on the bobbins, which for their smallest size rope machine are about 12in. traverse by 8in. heads. One hand can attend to eight machines, which require 1-horse power to drive them. They can be arranged to make ropes 2, 3, 4, 5, or 6 strand, as may be desired. Each of the strands may consist of one or of as many ends as is found necessary. Moreover, the separate strands may not only consist of several ends, but they may be subdivided into three sub-strands, which, being individually twisted, each of the 2, 3, 4, 5, or 6 strands before referred to is thus cabled and made into a threefold cord, and in this manner a rope of 6 strands may really consist of 18 strands. This is a new departure in making a cabled rope all at the one process. In addition to their rope and cord-making machinery, Messrs. W. T. Glover and Co. exhibit their new standard wire gauge. This gauge comprises four separate scales, three of them being verniers. The long scale marked S.W.G. gives the diameter in the new Board of Trade standard wire gauge. This differs but very slightly from the old Birmingham wire gauge; for instance, No. 12 B.W.G. has a diameter of 0·109in., and in the S.W.G. it has a diameter of 0·104in. The wire or other article to be measured is placed between the jaws and nipped tight, the reading being taken on the scales. The S.W.G. vernier is a peculiar one, and is read by observing the numbers of the graduations which coincide, the two numbers being identical. For instance, if a well-worn penny be nipped between the jaws it will be found that the graduation between 16 and 20, that is 18, will be opposite the corresponding graduation; the thickness is therefore 18 S.W.G. If a No. 8 S.W.G. wire be nipped it will be seen that the inch scale reads 0·160, the millimetre scale a shade over 4—the exact size being 4·064—whilst the scale of areas registers 20—·020—this giving at the same time the current in ampères—20—that the wire will safely carry. The area multiplied by ·4 gives 8 lb. per 100ft., and so on throughout the other calculations as to resistance, horse-power, &c. Again, No. 14 S.W.G. reads as 0·080 on inch scale, 2 millimetres on the millimetre scale, and 5—·005—on the scale of areas giving 5 ampères as the safe current for this wire. Other examples could be given, but these will serve to show the use of the gauge, although the scale of currents—1000 ampères to the square inch—may not accord with particular theories, yet for all practical purposes this will be found sufficiently accurate. The two other verniers are graduated in decimals of an inch, by which the reading may be taken in "mils" (or thousandths of an inch), or in decimals of a millimetre. The verniers for accurate measurements should be read by lens. On the back of the gauge is a scale by which the areas of circles, whose diameters are nipped between the jaws, may be approximately measured in thousandths of a square inch. From this scale may be computed the capacity of high conductivity copper wire for carrying an electric current by any of the well-known formulæ; but it is found that at all events up to No. 6 S.W.G., which is the largest diameter the gauge will take, 1000 ampères to the square inch is generally satisfactory, from considerations both of economy and resistance. The scale of areas may then generally be taken as a scale of ampères. The carrying capacity of the copper wire on an armature or magnet may be found at once by multiplying the coefficient applicable to the particular case. The area in the following is to be taken as in thousandths, as read on gauge, not in square inches. If the area be multiplied by 12·33, the result is the length in feet of pure copper wire having a resistance of one-tenth of an ohm $\left(\frac{\text{Ft.}}{0{\cdot}1 \text{ ohm}}\right)$. For practical purposes the multiplier may with greater accuracy and facility be 12. If the area be multiplied by 0·4—more accurately 0·386—the result is the weight in pounds of a length of 100ft. $\left(\frac{\text{Lb.}}{100\text{ft.}}\right)$. The area multiplied by 0·323 equals Sir William Thomson's very safe rule of 0·5 ampères to the square millimetre. The area multiplied by 0·0575 gives the horse-power lost per mile, with 1000 ampères per square inch. 42·8 divided by the area gives the resistance in ohms per mile.

Bell's friction brake for rope pulley block, illustrated in the annexed engravings, is also exhibited by Messrs. Glover and Co. The object of this friction brake upon rope pulley blocks is to suspend or lower any weight, and to avoid fastening the rope end. The friction brake is made to span the block, so that the pin which carries the sheaves carries the brake also, whilst it is further supported by the bottom bolt which binds the block. The brake is attachable to any existing pulley block, and its action is thus:—Each rope passes through a groove in the brake, the inner half of which is fixed, whilst the outer half is made movable by means of right and left screws secured into the fixed half of brake, when, in turning the pulley wheel by means of a small band, the two wheels revolve and act together in forcing the movable half of brake against the ropes, and thus grasp all the ropes at the same time. The grip is powerful, so that any weight the blocks are capable of lifting is secure. The load cannot descend until the wheels are reversed. Of course there is no tendency of the wheels to turn of themselves. A light spiral spring is placed on the right and left-hand screws, in order to free the brake from the



BELL'S FRICTION BRAKE FOR PULLEYS.

rope the moment the pressure is released. The band or cord has a turn and a-half round the pulley, which makes it unnecessary to hold both sides of band, leaving one hand free to guide the descending weight or to hold the rope of the pulley blocks. The same firm exhibits Bell's patent low-pressure filters, as used



BELL'S LOW-PRESSURE FILTERS.

for connection with steam boilers. They have very large filtering surface in a small space. In the engraving herewith what is termed the first filter bed is charged with material of very little value, and when saturated with filth it is raked out and thrown away. The cost of re-charging is, we are told, a few pence. A door with india-rubber facings is hung on against the side of cistern, in a line with the first filter, which is instantly removed, there being no bolts or nuts used, but simply two handles. A surface tap is placed on a level with top of this filter for slushing out the surface deposit. The second cleansing filters are those arranged vertically in double sets. The vertical position of these filters prevents settlement of deposit on the surface, most of it falling to the bottom of the cistern, where it is blown out of the sludge tap. The filters are immersed in the water, the water passing through the perforations and through the filtering material to the centre from both sides at the same time, and from thence through the valves into the longitudinal pipe, and forward to where it is required. In order to cleanse the filters, a back-pressure valve is attached to the other end of longitudinal pipe, which conveys the pressure to the inside of vertical filters, where it drives the filth outwards, which falls to the bottom of the cistern, and thence through the slush tap. A scum tap and air tube are also provided. This filter can be used equally well either as a filter, for a fall of water, or for a low-pressure suction.

THE INSTITUTION OF CIVIL ENGINEERS.

THE first annual general meeting under the revised bye-laws, passed last April, was held on Tuesday, the 2nd of June, 1885, the president, Sir Frederick J. Bramwell, F.R.S., being in the chair.

In the report of the Council it was observed that the statement of receipts and expenditure presented to the meeting contained the pecuniary transactions of the four months between the 1st of December and the 31st of March, the period to which the accounts were now carried, in accordance with the new bye-laws. At the later date there were on the books 20 honorary members, 1485 members, 1932 associate members, and 507 associates, besides 843 students. With regard to the students attached to the Institution, it was observed that they constituted an increasing source of strength to the parent body; inasmuch as nearly one-half of those admitted were ultimately elected into the corporation.

The inconvenience of holding the annual general meeting on the Tuesday previous to Christmas Eve having been admitted at the last general meeting, the council came to the conclusion that the last Tuesday in May, or should that be the Tuesday in Whitsun week, then the first Tuesday in June, was the best to recommend for the annual meeting, since at that time many members were in town for a number of purposes connected with parliamentary committees, and with business of various kinds; and commonly the president's *conversazione* took place at the end of May. In convening a special meeting, to submit to it a proposition for effecting this alteration, which was approved by the members, the Council took the opportunity of putting forward resolutions for making more harmonious the needed qualifications of candidates, and of clearing up obscurely worded passages in the bye-laws. With respect to the latter, the Council thought it fair that all persons making London their place of business should be considered residents, and should pay the residents' subscription. In some cases the objection had been made that "residence" meant the place where a person slept, and that where he did not sleep at his office, but in some suburb without the ten-mile radius, he was not a resident, although he had the full advantages of the Institution. A proposition was therefore submitted and carried that those members, associates, and students whose place of business or whose residence was within ten miles of the General Post-office, should be considered residents. Another question which had arisen was as to the legality of "pumping" in the election of Council. It had been felt that the Institution was entitled to the judgment of all the voters upon the whole Council, and that the duty of the voter was not to secure the election of a particular gentleman or of certain gentlemen in whom he felt an interest, but was to secure the return of a full Council. To further this object it was submitted and resolved that in the balloting list for Council, the number of names on the list, after erasure or substitution, must be the number to be elected, without the repetition of any of them.

As some slight misapprehension existed as to the effect to be given to the condition for admission into the Institution as a corporate member, that the candidate should be actually engaged at the time of his application for election, in the design or in the construction of such works as were comprised within the profession of a civil engineer as defined by the charter, the Council stated that the words were only meant to be operative against persons who had left the profession, and were not intended to apply to engineers temporarily out of employment.

During the session twenty-four ordinary meetings were held, at which twelve papers had been read and discussed, and one other paper had been read, but its consideration was postponed till next term. For some of these communications the Council had awarded medals and premiums, as under:—A Watt Medal and a Telford Premium to Professor H. S. H. Shaw; a George Stephenson Medal and a Telford Premium to Mr. W. Stroudley; a Telford Medal and a Telford Premium to Mr. P. W. Williams; and Telford Premiums to Mr. D. S. Smart, to Mr. A. Jamieson, and to Mr. W. Shelfold. The special thanks of the Council had been recorded to Messrs. Benjamin Baker and John Wolfe Barry, for the valuable descriptions they had given of the design and construction of the works of the Metropolitan and the Metropolitan District Railways. For papers to be printed in the "Proceedings" without being discussed, a Telford Medal and Premium had been awarded to Mr. W. G. Brounger; Telford Premiums to Professor W. C. Unwin, Mr. T. Andrews, Mr. J. G. Mair, and Mr. J. Craig, and the Manby Premium to Mr. C. W. Kinder. There had been twelve supplemental meetings for students, at which as many papers had been read, and to eight out of the twelve papers Miller Prizes had been awarded. The authors of the successful communications were Mr. F. G. Howard, Mr. H. H. Dalrymple-Hay, Mr. F. W. S. Stokes, Mr. H. T. Turner, Mr. W. Kidd, Mr. S. R. Lowcock, Mr. E. J. M. Davies, and Mr. F. H. Hebblethwaite.

There had been received on account of income between the 30th of November and the 31st of March, a sum of £11,061 8s. 7d.; on account of capital, £1973 15s.; and on account of trust investments, £83 17s. 7d.; making the whole receipts for the four months, including a balance of £1015 5s. 3d. brought into the account, £14,134 6s. 5d. On the other hand the expenditure had been for the same period £4297 5s. 11d. Investments had been made on capital account of £6232 15s. The trust fund expenditure had been £368 6s. 9d., while there remained £3235 18s. 9d. available—with the uncollected income yet to be received—for meeting the expenses of the remaining nine months of the present year. The before-mentioned £6232 15s. stated has having been invested had purchased £3000 New Three per Cents. and £3000 Metropolitan Board of Works Three and a-Half per Cent. Stock. These further investments brought up the Institution capital to £54,000, all of which was placed in such securities as were sanctioned by the Court of Chancery for trust investments. No change had been made in the capital of the trust funds, which remained as at the 30th of November, 1884, namely, £14,642 13s. 10d.

In conclusion, the Council trusted the members would agree in thinking that the experience of the period since the last report was eminently satisfactory, and that there was good reason to hope the Institution would continue that career of honour and usefulness which it had pursued for so many years—a career which caused it to rank among the foremost of those voluntary associations of private individuals for the promotion of public good, which, asking nothing from Government except the privilege of being left alone, had largely contributed to give to this country the prominent position she held among the industrial nations of the world.

The adoption of the report having been duly moved and seconded, was declared to be carried, and ordered to be printed in the "Minutes of Proceedings" in the usual manner. Hearty votes of thanks were then passed to the president, the vice-presidents and other members of Council, to the lecturers, to Messrs. B. Baker and J. Wolfe Barry, the auditors, to the secretaries, and to the scruti neers, for services rendered to the Institution.

RAILWAY MATTERS.

THE first sod of the North Trunk Railway had at departure of last mail from New Zealand been turned by the Maori chief, Wahanui.

THE New Zealand revenue for the year ending March 31st showed a surplus of £30,000, but in railways and stamps there was a deficiency.

THE Great Western Continental service, between Weymouth and Cherbourg, will be discontinued on the 30th instant, together with the through booking of passengers to stations on the Western Railway of France.

IT is said that Parliament will, next session, be asked for powers to construct the oft projected line between Portsmouth and Basingstoke, to place the Great Western system and Portsmouth in direct communication with the Midland and South Wales coal-field.

TWO cars are now running on the Midland Railway which, though of smaller dimensions than the Pullman cars hitherto in use, and though built without end platforms, and with doors at the sides instead of at the ends, are, for some reason or custom, called Pullman cars.

THE new river tunnel on the Cincinnati Southern Railroad, in Tennessee, about 100 miles from Chattanooga, fell in on the 11th inst., owing, it is reported, to the vibrations caused by a train which was passing through, but presumably the tunnel was not up to the work. It fell upon the cars, and nearly everyone in them was hurt, six persons being killed and twenty severely injured.

IT has not been officially announced by the South-Western Railway Company, but it should be made known to the general public, that any passenger, not accustomed to the very frequent use of the Waterloo collection of station sheds, should invariably arrive at least half an hour before the advertised departure of the train wished for. It takes about that time to locate booking-offices and trains.

THE complaints of the Belgian colliery owners with regard to the advantages granted by the Belgian railway tariffs to the German collieries are becoming general. M. d'Audrimont has accused the Germans of an intention to obtain possession of the whole of the coal trade in Belgium. The Belgian colliery owners require a reduction of the railway tariffs to enable them to compete with the Germans in those parts of Belgium where German coal has been introduced.

THE Worcester and Broom Railway Bill, which has already passed the House of Commons, came before the examiners of the House of Lords this week for proof of compliance with the Standing Orders. It is a Bill to incorporate a company for making a railway from Worcester to the Evesham, Redditch, and Stratford-on-Avon Railway at Broom. The capital proposed to be raised by shares is £150,000, and by loan £60,000, and the length of the line is sixteen miles. There was no opposition, but certain formalities had not been complied with, and the Bill was therefore referred to the Standing Orders Committee.

COMPLAINTS are constantly being made by passengers using the Great Northern trains running on the Metropolitan Extension of the London, Chatham, and Dover Railway. They complain of being forcibly thrown from the carriages as they are stepping to the platform by the sudden recoil of the brakes. A considerable period elapses between the stoppage of the train and this recoil, and hence even the most careful passengers are liable to being thrown as they step from the footboard. Several passengers have been thrown in this way, and insult is then added to injury by their being told to be more careful.

THE soundings for the piers of the railway bridge, 3000ft. long, to be built over the Hawkesbury River, New South Wales, Australia, show that the foundations for piers must be put down to a greater depth than ever yet attempted, the water in some places being 77ft. deep, and in others, where the water is 45ft. deep, the mud and sand is 125ft. deep, making 170ft. in all to sink the piers below tide. This bridge is to be for a double line, and will cost over £400,000. Sir Saul Samuel, on the part of the Government, has named a board of engineers, to meet in London, to examine and report on the plans and tenders sent in by the bridge builders. The board named consists of Sir John Hawkshaw, C.E.; Colonel Douglas Galton; and Mr. W. W. Evans, M.I.C.E., of New York.

THE accidents on American lines in April last are classed as to their number and causes by the *Railroad Gazette* as follows:—Collisions: Rear, 17; butting, 5; crossing, 3; total, 25. Derailments: Broken rail, 5; broken bridge, 3; spreading of rails, 7; broken wheel, 2; broken axle, 3; broken truck, 3; broken draw-head, 1; cattle, 1; land-slide, 1; wash-out, 3; wind, 1; misplaced switch, 5; malicious obstruction, 1; unexplained, 16; total, 52. Other accidents: Boiler explosion, 1; broken parallel rod, 1; falling rock in cut, 1; car burned while running, 1; total, 4. Grand total, 81. Three collisions were caused by mistakes in orders or failures to obey them; two by misplaced switches; two by failure to signal following trains after an accident; one by a train breaking in two, and one by a flying switch.

REFERRING to the flooding of a part of the Metropolitan Railway by the bursting of a sewer last week, Sir Joseph Bazalgette made the following report to the Metropolitan Board of Works:—"I beg to report that on Monday afternoon last, a little before four o'clock, the old local sewer on the east side of Sloane-street, near Sloane-square, in consequence of being overcharged by an excessive fall of rain, burst out its side, and discharged a large body of water into the works now in progress there for the construction of the Ranelagh storm relief sewer, and thence flowed into the Metropolitan District Railway, the traffic on which was stopped for the night. The breach in the old local sewer was made good by eight o'clock in the evening, and the water in the railway tunnel was got out by means of the company's fixed engines and pumps the same night."

THE shareholders of the South Staffordshire and Birmingham and District Steam Tramways Company have confirmed their former resolution increasing the capital of the company to £350,000, by the creation of 5000 additional shares of £10 each. A select committee of shareholders report that the development of goods traffic is essential to the prosperity of the concern, and they propose that a private syndicate, with whom negotiations have already commenced, should work the collection and delivery of goods, the company providing only the haulage power over its own lines. The proposal contemplates the running of trains of three small trucks each capable of carrying 3 tons, and the offer would be to pay the company for such haulage at a rate which would give 1s. 1½d. per mile. As the actual cost of running would not exceed say 7½d. per mile, this would leave a profit of something like 6d. per mile. The chairman of the company has promised that these recommendations shall be carried out, and the Board of Directors is to be reconstituted.

MR. J. B. SCOTT, in his report on the coal trade for May, says that, during that month, 501,664 tons were brought into London by rail and canal, against 561,650 at the same date of last year. The amounts carried by the different routes in that month and in May of last year were, in tons:—

	1885.	1884.
London and North-Western	111,005	127,029
Great Northern	61,253	85,500
Great Western	71,149	77,604
Midland	170,566	203,286
Great Eastern	78,579	60,281
South-Western	6,254	5,151
South-Eastern	1,827	1,817
Grand Junction Canal	1,029	980

The Great Eastern is, it will be seen, the only company which carried more in the past than in the corresponding month of last year. For the five months of the current year the total brought into London by rail and canal was 2,878,922 tons, or 87,160 tons more than in the same period of last year.

NOTES AND MEMORANDA.

A MIXTURE of sulphuric acid and bichromate of potash will clean glass which is cleaned with difficulty without it.

THE six healthiest places last week were Derby, Sunderland, Halifax, Wolverhampton, Bristol, and Portsmouth.

IN Greater London 3177 births and 1636 deaths were registered last week, corresponding to annual rates of 31·9 and 16·4 per 1000 of the population.

THE deaths registered during the week ending June 13th in twenty-eight great towns of England and Wales corresponded to an annual rate of 18·6 per 1000 of their aggregate population, which is estimated at 8,906,446 persons in the middle of this year.

THE number of hours of bright sunshine recorded at Greenwich by Campbell's sunshine instrument during 1884 was 1115, which is about 100 hours less than the average of the seven preceding years. The aggregate number of hours during which the sun was above the horizon was 4465, so that the mean proportion of sunshine for the year was 0·250, constant sunshine being represented by 1.

GENERALLY accepted observations in different parts of the world have demonstrated that the temperature of mines increases about 1 deg. every 64ft. A number of reports had been received by the Mining Department of Victoria, which showed that this is not invariable. In Lansell's No. 180 Mine, Sandhurst, on Feb. 18th, at 1660ft., the temperature was 78 deg., and at 1760ft. level, 75 deg. The *Colonies and India* says that the inspectors have been requested to furnish a report on this variation from general experience.

IN London 2464 births and 1315 deaths were registered last week. Allowing for increase of population, the births were 116 and the deaths 184 below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes, which had been 19·9, 19·6, and 19·4 in the three preceding weeks, further fell last week to 16·8, a lower rate than has prevailed in any week since September last. During the first ten weeks of the current quarter the death-rate averaged 20·1 per 1,000, against 21·4, the mean rate in the corresponding periods of the nine years 1876 84.

IT is stated as the result of microscopical examination by MM. Osmond and Werth that molten steel possesses a kind of cellular tissue, the iron forming the nucleus and the carbon the envelope of the cellules. Referring to the record of the examinations, the *Scientific American* says: "These simple cellules form agglomerations which the authors term compound cells. These latter cells may be easily identified with what is ordinarily called the grain of the steel; their surfaces are therefore regions of least cohesion. Hence the fracture of a bar of steel is the surface which contains a minimum of carbon."

ELECTRICITY has now been applied for cutting glass tubes—an operation of some difficulty when the diameter is large. The "Journal" of the Society of Arts says: "An iron wire half a millimetre in diameter is wound round the tube at the place required to be cut, and the ends are connected by means of copper conductors of the same diameter, with the poles of a powerful battery or other generator of electricity. This iron becomes heated when the current flows, and it is only necessary to cool it suddenly with a few drops of cold water in order to produce a clear cut. Glass tubes 4in. in diameter are now cut in this way."

M. E. H. AMAGAT has constructed apparatus by which he is able to subject gases to a pressure of about 400 atmos. He has several times reduced oxygen to one nine-hundredth part of its original volume, and under these conditions the density of the oxygen is considerably higher than that of water. Under the highest pressure yet obtained, the density of the oxygen was higher than 1·25, the surrounding temperature being 17 deg. It is evident, therefore, that unity is not the limiting density of oxygen. The limiting density of hydrogen—given in the "Journal" of the Chemical Society—as deduced from the author's experiments, is 0·12.

THE *rôle* of wind in fertilising the ground is remarkably illustrated, according to M. Alluard, by the very fertile valley of Limagne, in Auvergne. The prevalent winds there are west and south-west, and traverse the chain of the Dômes, where are vast deposits of volcanic ashes. Much of this dust is thus carried to the Limagne valley, and settles there of itself, or is carried down by rain or snow. As it contains a large amount of phosphoric acid, potash, and lime, it is highly fertilising, and its very fine state favours rapid assimilation. From observations on the Puy de Dôme, *Nature* says, M. Alluard estimates the annual deposit at 348 to 400 grammes per square metre.

IN the report of the Astronomer Royal it is mentioned that the iron gutter of the Lassell dome—in sixteen pieces, weighing together 2 tons 6 cwt.—did not affect the magnetic registers in the slightest degree when it was brought into the South ground on June 26th, 1884. In order to determine the effect of a mass of iron on the magnets, experiments were made on July 2nd with four, eight, twelve, and sixteen pieces of the gutter respectively, placed at a distance of 25ft. from the declination magnet in a direction south-east—magnetic—from it, so that the maximum effect would be produced. It was found that the effect of every four pieces, weighing together about 12 cwt., was to increase the apparent declination by 1 min. exactly, the whole sixteen pieces causing a deflection of 4 min. As the effect of a mass of iron on a magnet varies as the sine of twice its magnetic azimuth divided by the cube of its distance from the magnet, these experiments show that the deflection caused by the whole of the iron in the Lassell instrument and dome—which is at a distance of 100ft., and very nearly in the magnetic meridian of the declination magnet—would be quite insensible.

IN answering a question on the range of modern guns in the American Navy, the American *Army and Navy Journal* says that the ranges of modern heavy guns are not tested for extreme ranges and at high elevations. Krupp, "Expériences de Tir," No. xlvii., Meppen 17 Août, 1883, gives the range of the 30·5 cm. rifle, 35 calibres long, at an elevation of 14 deg., as 10,165 metres. No. 44, Meppen, July 31st, 1883, that of the 26 cm. rifle of 35 calibres length, with an elevation 20 deg., as 11,526 metres; projectile, 275 kilogs.; initial velocity, 530 metres. At Gâvre, 1880, the French 34 cm. steel rifle, with an elevation 38 deg., showed a range of 12,918 metres. The authority, Hélie Balestique II., p. 204 and 278. The "Revue Maritime et Colonial" for May, 1885, gives the range of the new French rifled 21 cm. mortar as 3944 metres, with 45 deg. elevation, and 3212 with 60 deg. elevation. In his prize essay on "Improvements in the Art of War," Military Service Institution, 1882, Colonel Lazelle reports the following ranges: Krupp rifled 28 cm. (11in.) howitzer of 1879, elevation 28½ deg., 8000 yards; Krupp's 15 cm. B.L. howitzer steel, 45 deg., 6550 yards; 200 lb. Parrott, 4272 yards, 11 deg. 47 min. elevation. American muzzle-loader, 11in. rifle, altered, 6038 yards, with 14 deg. elevation; 8in., 9419 yards, with 27½ deg. elevation. Of ten shots from Krupp's 4½in. field gun fired at a horizontal target 10,300 yards distant, nine were included within 18 yards of lateral deviation. The greatest effective ranges of the European field guns firing common shell is given at from 5000 to 8000 yards; using shrapnel shell, 3000 to 3800 yards. Greene gives the following ranges of Russian guns: Bronze, 9 lb., 5000 yards; bronze, 4 lb., 3800 yards; steel, 4 lb., 7000 yards. Maguire, in his "Attack and Defence of Coast Fortifications," gives the maximum range of the Krupp 15 cm. and 28 cm. guns with shell as 8000 yards. None of these authors cite their authorities. The new French long range cannon, De Bange system, sent to the Antwerp Exhibition, weighs 37 tons, is a fraction under 37ft. in length, and throws a 1000 lb. projectile a distance of 12 miles 752 yards (20 kilos). The author of this new piece destined for coast defence is the ex-Colonel De Bange, now at the head of a large private firm, who is said to have retired from the service in disgust, and yet his guns, from the smallest mountain to the largest position piece, have been adopted by an ungrateful country.

MISCELLANEA.

AT the Birkenhead and Wirral Agricultural show, Messrs. Ransome and Marshall, of Liverpool, have received the gold medal for their exhibits, which include Messrs. Burrell's 14-horse power compound under type engine, a 6-horse horizontal and a 4-horse combined vertical engine by themselves, and a collection of Wells' pulleys, and a Sherwin's disintegrator.

THE mean temperature of the year 1884 was 50·7 deg., being 1·4 deg. higher than the average of the last forty-three years. The highest air temperature in the shade was 94·1 deg on August 11th, and the lowest 24·5 deg. on November 25th. The mean monthly temperature was above the average, excepting in the months of April, June, October, and November.

LARGE shipbuilding contracts have been entered into on the Clyde. Messrs. John Elder and Co., of Govan, Glasgow, have contracted to build three steamers of 5500 tons for the North German Lloyd's. The steamers will be fitted with all the latest improvements. The news has been received with great satisfaction in Govan, where thousands of men are idle.

THE annual general meeting of the Chesterfield and Derbyshire Institute of Mining, Civil, and Mechanical Engineers, will be held in the Guild Hall, Derby, on Thursday, 25th June instant, at two o'clock. The following papers will be open for discussion:—Mr. A. H. Stokes' paper, "Colliery Explosions;" Mr. P. M. Chester's paper, "Colliery Winding Ropes and their Attachments to the Cage;" Mr. Arnold Lupton's paper, "Mining in North America." The following papers will be read or taken as read:—"The Kaiping Coal Mines, China," by Mr. James Stevens, Kaiping, China; "Description of a Fire-damp Indicator," with experiments, by Mr. A. H. Maurice, Cardiff.

THE Pittsburg iron strike was on Tuesday compromised, by means of a joint meeting of the committees representing both sides. The strike ended in Pittsburg by the employers conceding the major portion of the workmen's demands, the latter accepting a 10 per cent, reduction in their wages for the coming year. The Pittsburg mills can resume work if the masters wish it, and several have already started their fires. The strike to the west of Pittsburg continues. The masters, declining to yield, withdrew yesterday from the conference. The mills of Chicago, Cincinnati, Wheeling, Mahoning, and Shenango are still idle, keeping unemployed about one-third of the total number of the workmen who struck. The ironmasters state that the three weeks of idleness during the strike have reduced the output, so that the market is in a healthier condition.

SIR FREDERICK BRAMWELL, F.R.S., President of the Institution of Civil Engineers, was entertained at dinner by the Council of the Institution last Wednesday evening. The other guests were the Marquis of Hamilton, C.B., vice-chairman; Mr. Edward Cunliffe-Owen, secretary of the Inventions Exhibition; the Right Hon. Lord Bramwell, F.R.S.; and Sir Frederick Abel, C.B., F.R.S. Honorary Members: Mr. Head, president of the Mechanical Engineers, and Mr. Spagnoletti, president of the Telegraph Engineers. The hosts were: Mr. Fowler, Sir Charles Hutton Gregory, K.C.M.G.; Mr. Hawksley, F.R.S.; Mr. Bateman, F.R.S.; Mr. Abernethy, Sir W. G. Armstrong, C.B., F.R.S.; and Mr. Brunlees, past-presidents. Mr. Woods, in the chair; Mr. Bruce and Mr. Berkeley, vice-presidents; Mr. Baker, Mr. Barry, Sir Henry Bessemer, F.R.S.; Mr. Cowper, Sir James N. Douglass, Mr. Fox, Mr. Giles, M.P.; Mr. Hayter, Mr. Mansergh, Mr. Preece, F.R.S.; Sir Robert Rawlinson, C.B.; Sir Edward Reed, K.C.B., F.R.S., M.P.; Mr. Stileman, Mr. W. Anderson, Mr. W. B. Lewis, Mr. Radcliffe, Mr. J. S. Hargrove, Mr. H. Bauerman, Mr. E. Bazalgette, Mr. Harris, Dr. Pole, F.R.S., honorary secretary, and Mr. James Forrest, the secretary.

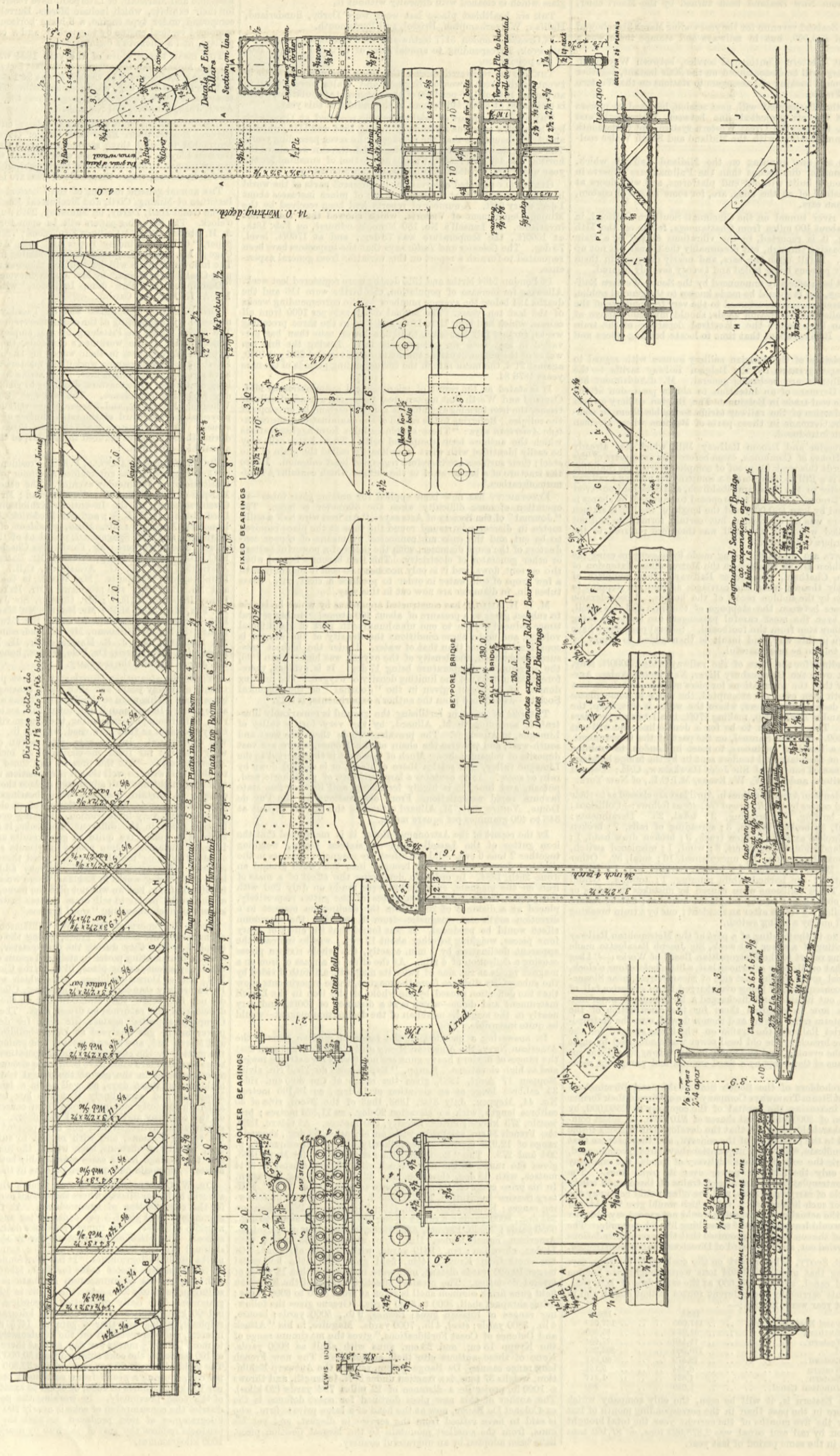
WHEN the steamship Himalaya was first put in service—some twenty or thirty years ago—her stern bearing was fitted with a brass bush. This wore so rapidly that it was a constant source of annoyance. In one case it cut down half an inch during a short run. After some experimenting, the lignum-vitæ bearing, substantially the same as that now used, was put in. No further trouble was experienced. In one case, after a run of 18,000 miles, the wear was not far from one-eighth of an inch. The *Industrial American* says:—"At the present day these bearings give little trouble, and wear so well that it is a question whether bearings of this kind might not with advantage replace those of metal in many cases. In certain positions wood bearings show remarkable freedom from wear, and the testimony of an old millwright is that they run with very little friction. Looking over the coefficients of friction given in the different handbooks, it appears that metal surfaces on wood give quite as good results as metals on metals. In some instances, where proper lubricants are used, the results obtained by using metals on wood exceed those of any other combination of materials." And we may add that there is one large engineering works in England where wood bearings are used for the shafting, but we will not give the name, because the owners of the works prefer to sell brass brasses instead of letting people know too much about the "wood brasses."

FROM the report of Dr. A. W. Williamson, F.R.S., chief gas examiner of the Board of Trade, giving the daily testings of gas supplied to the City during the past quarter, it appears that the average illuminating power in standard sperm candles had been, at the Jewry-street testing-place, 16·4; at the Clothfair testing-place, 16·4; and at Dorset-buildings, 16·3—which was higher than the Parliamentary standard. At King-street, Clothfair, the minimum did not fall below that standard, but at the other testing-places deficiencies were returned on fifteen days. The Gas Light and Coke Company appealed against the tests for deficient illuminating power in the gas analysed at Dorset-buildings on January 26th and March 2nd, and after a careful and prolonged examination of the matter by the chemists of the Corporation, the conclusion was come to that there must have been some circumstance which caused a deterioration in the gas at the official testing-room at Dorset-buildings on those days, as well as in a lesser degree on other Mondays, and accordingly that the low tests on those days, although correctly obtained, arose from causes beyond the control of the company and the official examiners. As regarded purity, sulphuretted hydrogen had not been present in the gas at any of the testing stations, and with respect to sulphur the maximum had, at all the stations, been within the limit fixed by the Act, and the average in all cases considerably better than the requirements. Ammonia had not been present in the gas.

DR. W. COHN recently gave some figures which he obtained from a works in Upper Silesia, where thirty coke ovens have been altered for the condensation of bye-products. At those works 100 kilogrammes of coal yield 3 per cent. of tar and 1 per cent. of ammonium sulphate. The thirty ovens coke daily 50,000 kilogrammes of coal. The price on the spot for tar is 4½ marks (1 mark = 1 shilling) per 100 kilogrammes, and for ammonium sulphate 25 marks per 100 kilogrammes. It has been found that the treatment of the ammonia water costs for fuel, labour, &c., 9 marks per 100 kilogrammes of ammonium sulphate produced, so that, the selling price being 25 marks, the profit is 16 marks per 100 kilogrammes. The daily production, according to the above figures, is 1500 kilogrammes of tar, and 500 kilogrammes of ammonium sulphate, giving together a gain of 147½ marks. The wages, interest, and depreciation on the condensation plant do not come to more than 47½ marks per day, so that there remains a clear gain of 100 marks on the coke obtained from 50,000 kilogrammes of coal. The yield of coke is 65 per cent., giving 32,500 kilogrammes of coke per day, showing a profit from condensed products of 0·31 marks per 100 kilogrammes of coke, or equal to exactly half the total cost of the coke previously. In working the poor iron ores of that district the consumption of coke is nearly 200 kilogrammes per 100 kilogrammes of iron produced, so that the profit from the bye-products reduces the cost of the iron by nearly 6 marks per ton of 1000 kilogrammes.

CONTRACTS OPEN—GIRDERS FOR BEYPORE AND KALLAI BRIDGES, MADRAS RAILWAY.

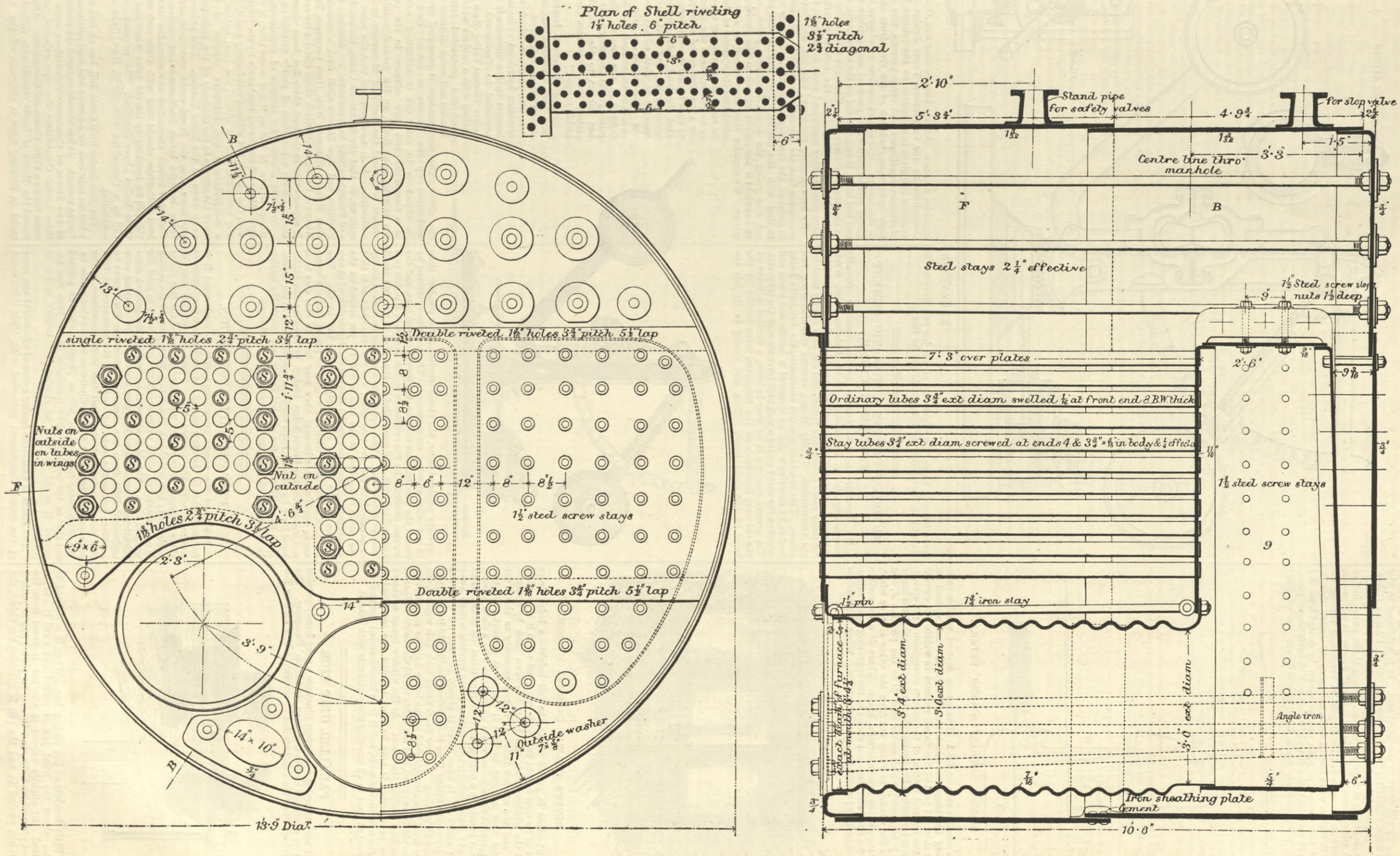
(For description see page 472.)



STEEL BOILER FOR THE STEAMSHIP EASTWOOD.

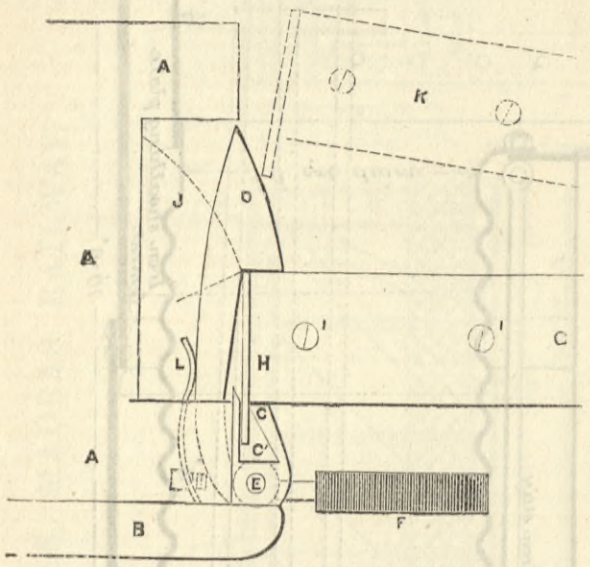
MESSRS. EARLE SHIPBUILDING COMPANY, HULL, ENGINEERS.

(For description see page 479.)



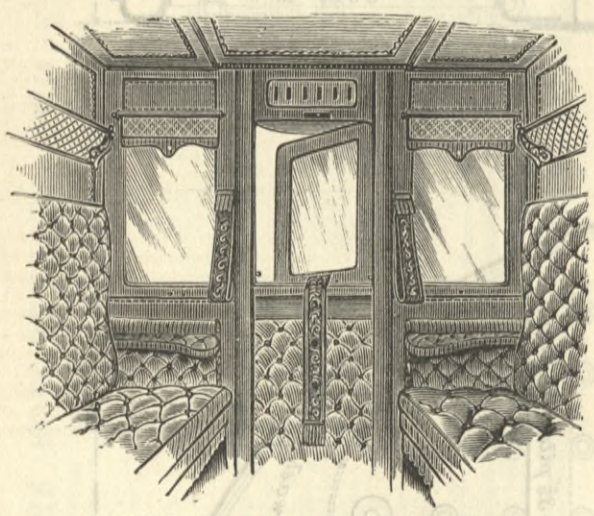
GOVER'S RAILWAY CARRIAGE WINDOW.

THE window illustrated below opens on either side, as well as moving up and down in the usual way. It is exhibited in the Inventions Exhibition by the inventor, Mr. H. Charles Gover. In the engravings A A A is the pillar or side of a railway door; B the moulding as fixed on present doors; C the entire fitting in one piece, screwed on side of door; C^1 groove in which the flange H on the sash moves; D part of the fitting turning on pivot E, which, when moved back, as shown by dotted line J, allows the window to open out, as shown by dotted lines K; E pivot on which the fitting D turns; F circular finger piece, which, when pressed, moves back D and opens the window;



GOVER'S CARRIAGE WINDOW, DETAILS.

G the window sash or light; H flange on side of window sash, forming the hinge on which the sash turns when opened on other side; I I part of the flange, reduced in width, and carried over the top and bottom of the sash to strengthen it; L spring. When it is required to open out the window on one side, the finger piece F is pressed, which moves back D to the position J, and allows the window to swing out from the other side, on which the flange in the groove forms a hinge. There is a connection between the two sides—not shown in the engraving—preventing both sides being wantonly opened together. When the window

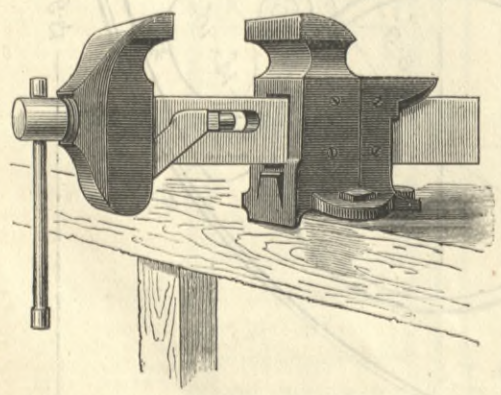


GOVER'S RAILWAY CARRIAGE WINDOW.

is shut—that is, pulled up to the full height—a ledge drops under of its own weight and holds it up, and when it is required to let the window down, this ledge is drawn back by a finger-piece and the window falls. It is not necessary to throw the window over a ledge to hold it up, as at present. By this arrangement the window works up and down in a close groove, and not loosely in a cutting three or four times its width, as at present; consequently, the rattling of the window is done away with; and even if, after wear, it should become too easy, the pressure of the fitting D on the window would hold it tight, and prevent all rattling. In new doors fitted with this window, the pillars would be strengthened at the lower half, as no grooving out would be required, and the lights would also be strengthened by the iron binding the frame. As the window opens as shown in the perspective, it may be open without the inconvenient draught now unavoidable, and it is an improvement that might be fitted at least to all smoking compartments with benefit.

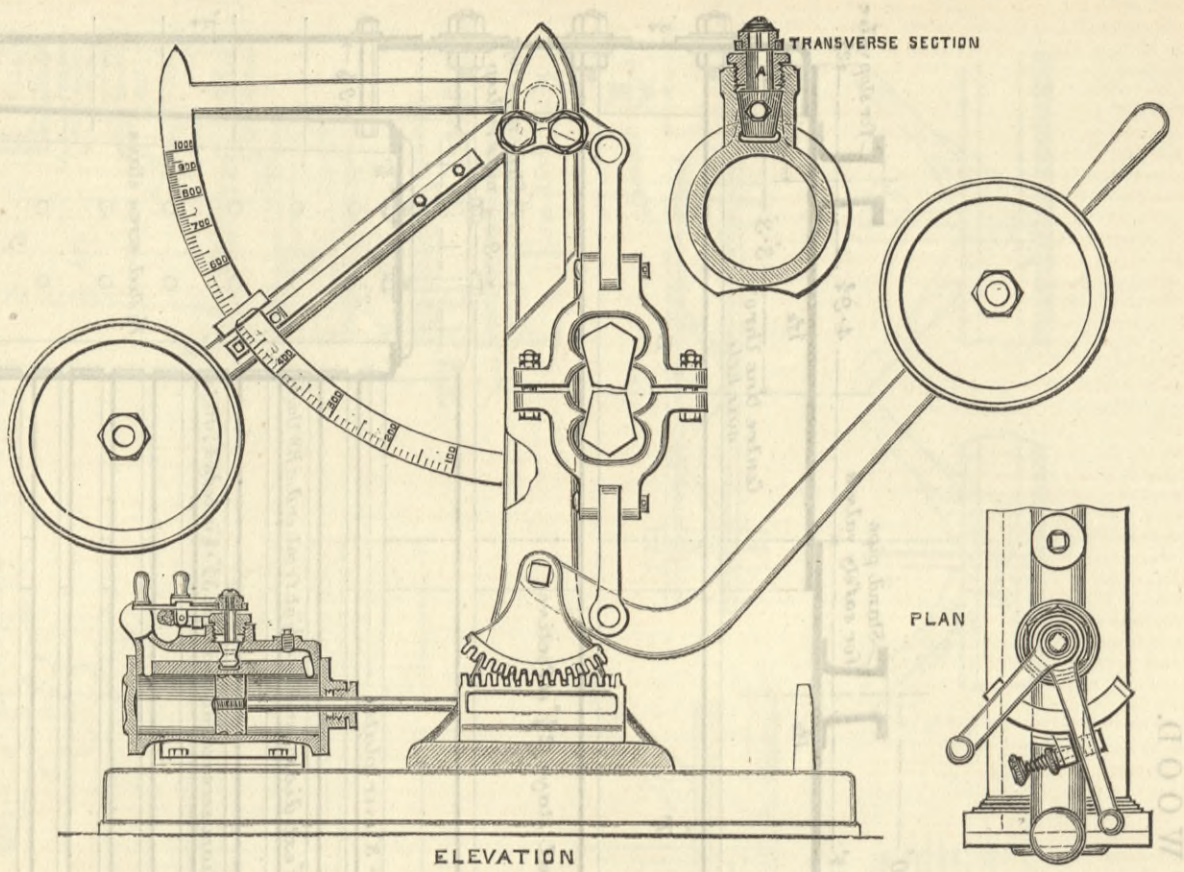
PARALLEL GRIP VICE.

THE accompanying engravings illustrate a very handy parallel grip vice exhibited by the Coventry Machinists' Company. The engravings show the construction of the vice. The moving jaw



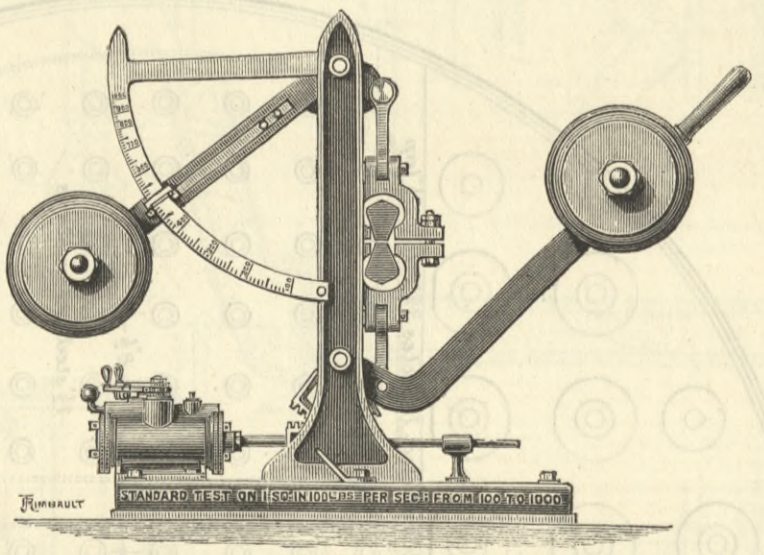
has a little freedom on the sliding bar. When it is desired to grip an object the front jaw is pulled out until it can be admitted. By slightly raising it the bar is freed from the toothed piece which holds, and it may be pulled out or pushed in. When pushed in and the jaw is touching the object, the screw forces it home, the slight play of the jaw and traverse for the nut in the sliding bar being sufficient for this.

MICHELE'S AUTOMATIC CEMENT TESTING MACHINE.



MICHELE'S PATENT AUTOMATIC CEMENT TESTING MACHINE.

WE illustrate a new cement testing machine recently patented by Mr. V. De Michele, of 14, Delahay-street, Westminster. A cement testing machine of his design has been now for many years before the public, and has been largely used by the Government, Trinity House, cement manufacturers, and others. This machine was not automatic, the briquette being broken by exerting a pull by means of a handle and worm and wheel on the short end of a weighted lever through the briquette. The present machine is, as may be seen, a decided advance on the old one, inasmuch as the briquette, being broken by the lever on the right hand, falling, and raising in its fall the



opposite weighted lever, the strain applied is far steadier than in any other existing arrangement. The machine is started by one of the two handles seen in the elevation and plan, and the motion governed by the resistance to the motion of a piston in a small oil cataract, and controlled by the other of the two small handles referred to. The apparatus can thus be worked slowly or as quickly as the user may wish; but the standard test is that the strain be applied at the rate of 100 lb. per second on the square inch. The motion can be stopped and recommenced at any portion of the stroke by simply turning the handle. The machine is also made with the weights so placed that the levers are in equilibrium, wherever they may be. In this case it is not automatic, the bricks being broken by lowering the right-hand lever by hand. Both machines are exhibited in the Inventions Exhibition, and are of good design, and enable the testing to be performed with great convenience and efficiency.

PRIVATE BILL LEGISLATION.

IN view of the recent surprising events in Parliament it is fortunate that in the early part of the session such good progress was made with the private Bills. There are not now many of these measures of any class, and there are few of the first order undecided; but whether a dissolution takes place or the session is only shortened, some private schemes may come to grief for want of time. Should that result ensue from the present complications, it would furnish a new argument for carrying over unfinished Bills from one session or even one Parliament to another; but as the existing system is, the promoters of Bills still not far advanced may well feel some uneasiness. The position was illustrated by the Chairman of the Committee on the Manchester Ship Canal Bill on Monday, when he pointed out that as the session might terminate sooner than was expected, it would be wise to shorten the inquiry as far as possible.

The House of Commons having resumed a fortnight ago, some of the Select Committees proceeded with their interrupted inquiries at once. Among the number was Colonel Stanley's Committee on the Corporation Tower Bridge Bill. Further evidence was given in opposition to the scheme in the interest of various wharfingers and other persons who fear injury to their business on the banks of the river from the construction of this bridge. It is almost needless to observe that their case rested almost entirely on personal and private considerations, and had little, if any, bearing on the advantages of this bridge to the general community. That the Committee clearly appreciated this is evident from the fact that after one or two more sittings they announced their decision in these terms:—"We have carefully considered this Bill, and have come to the conclusion that the preamble is proved. We intend, however, to insist on the insertion of certain provisions when we come to deal with the clauses. They are to this effect. We are not now using the actual language, which, of course, will be put right if the parties submit to the decision of the Committee. We consider that there should be a regulation to the effect that the opening of the bridge should be continuous, whether vessels are passing or not, at or about the time of high water for a specified period to be fixed from time to time by the conservators. We consider that the land traffic should yield to the water traffic, and that clauses should be inserted to that effect; and that during the construction of the bridge there should be maintained not less than 160ft. fairway in the centre. There are other minor points that may occur on the clauses, but subject to the conditions I have stated, the Committee consider the preamble proved."

Several Municipal Improvement Bills have been advanced, but, as a rule, they possess only local interest. There is, however, one measure which deserves some attention by reason of its importance, and because such a measure is not very often presented to Parliament. This is the Lower Thames Valley Main Sewerage Bill, dealing with a subject which has aroused much and protracted interest both in London and some distance down and up the river. The new measure is promoted by various local authorities up the Thames as far as East Molesey, and its object is to carry out in statutory form the report of a Committee last year adverse to the continuance of the existing joint Board, on the ground mainly that such a system prejudiced the purifying of sewage by the individual authorities. It is now proposed that the joint Board shall be split up, so that the Richmond Union, Barnes, Kew, Mortlake, and Petersham may be constituted one district; that Kingston, Surbiton, and New Malden shall form a second district; and East Molesey, Hampton Wick, Ham Common, Teddington, and Kingston Union constitute a third district for sewage purposes. It appears that in the past there has been since 1877 a practically useless expenditure of nearly £80,000 on sewage works—for, even allowing for increase of population, the state of things is now as bad as, if not worse than, it was eight years ago. Many efforts having been made by the joint Board to deal with the matter, but without satisfactory result, Mr. Hawkesley was consulted, and he advised the local authorities to create a comprehensive and extensive scheme of their own to carry the sewage to the outskirts of the metropolis, and thence away down to the lower Thames. This proceeding, however, was more than the Board could undertake, and, the question being brought before Parliament last session, a House of Commons Select Committee recommended that the several local authorities should deal with their own sewage. Hence this Bill for breaking up the old joint Board and setting up the three bodies above described. The examination of this new Bill by a Committee, with Sir W. Hart Dyke as chairman, is continuing.

The Manchester Ship Canal Bill has at last reached a point when we may look for a speedy and final settlement of this long fought contest. It has already engaged the protracted attention of two House of Commons' Committees, once rejected, and three Lords' Committees, also once rejected, and now it has come before a third Commons' Committee. After the Bill last passed the House of Lords considerable difficulty was experienced in deciding upon a chairman of the new Commons'

Committee. Owing to certain peculiarities of the scheme several prominent members, otherwise highly qualified for the post, were not quite eligible, but eventually Mr. W. E. Forster was selected, and it may safely be said that a better chairman could not have been chosen. His colleagues are Lord Eustace Cecil, Mr. W. Fowler, and Mr. Dalrymple, and with these names in view it will be admitted that the Bill will not suffer through lack of a thoroughly competent Committee. The sixth inquiry began on Monday, the familiar formidable array of counsel appearing. At the outset Mr. Forster observed that the Committee could not but be alive to the fact that enormous sums of money had been spent on this project and vast quantities of evidence taken. Considering that, and also that while the present session could not in any case last very long, it might terminate with unexpected suddenness, he suggested that the several counsel should refer to some of the evidence already given more than once, instead of again repeating it, and he promised that the same consideration should be given to it as if put before the Committee in the usual way. Mr. Aspinall, however, on behalf of the petitioners, declined to accede to the suggestion, deeming it better to take the ordinary course, but undertook to curtail the inquiry as far as he could. He observed that in the House of Lords' Committee various suggestions had been made which had not only caused great inconvenience, but a miscarriage of justice. No less than twenty-two petitions for a hearing before the Committee were presented. There seems little doubt that the Bill will be passed by this Committee, and in that case, unless a sudden dissolution takes place, this gigantic scheme will pass into law in the course of a few weeks. In connection with Lord Camperdown's Bill for regulating the powers of the London water companies, which has aroused warm opposition in some quarters, it is interesting to note that the Kent Waterworks Company have promoted a Bill to extend their limits of supply, and for that and other purposes to enable them to raise £100,000 by the issue of debentures. The Bills came before a House of Lords' Committee, of which the Duke of Richmond was chairman, and five sittings were occupied. The chief opponents were the Metropolitan Board of Works, who objected on the ground that the Bill was unnecessary; that it would be unwise to grant these new powers when Parliament was considering the question of handing over the metropolitan supply to a public trust; that the Board intended to introduce a Bill empowering them to purchase the water companies when Parliament should have authorised the Board to deal with the question, and the present scheme would enhance the value of this undertaking, and so increase the purchase price. In the end the Committee refused to sanction the Bill and rejected it. The Committee next proceeded to consider the Southwark and Vauxhall Water Bill, which involves very much the same questions as the preceding scheme, and is also opposed by the Metropolitan Board of Works. Leaving now the measures proceeding before Select Committees, we may note the progress of Bills in the House of Commons itself since our last *résumé*. The following Bills have been read a first time:—Limerick and Kerry Railway, Stratford-on-Avon and Midland Junction Railway, Rhymney Railway, Taff Vale Railway, North London Railway, Bann Navigation and Railway, Belfast Central Railway (Sale), Belfast, Strandtown, and High Holywood Railway. A second reading has been given to these Bills:—Barry Docks and Railway, Columbia Market and Railway, East Usk Railway, Peckham and East Dulwich Tramways Extensions, Glasgow Corporation Water (Loch Katrine scheme), Hull Bridge Improvements, Selby Dam Drainage, Hartlepool Headland Protection, London Riverside Fish Market (extension of time). And while the schemes here mentioned have been ripened for the Committee stage, those which follow have passed their third and final reading: Dore and Chinley Railway, Manchester, Sheffield, and Lincolnshire Railway; Pontypridd, Caerphilly, and Newport Railway; Llangammarch and Neath and Brecon Junction Railway, Mersey Railway, North British Railway, Albert Palace Association, Bradford Waterworks and Improvement, Brentford and District Tramways, Central Argentine Railways, London Street Tramways (Extension), Midland Railway (Additional Powers), Rhondda and Swansea Bay Railway, Woking Water and Gas, Great Eastern Railway (General Powers), London and North-Western Railway, Metropolitan Board of Works, South-Eastern Railway (Various Powers), London, Tilbury, and Southend Railway, Bawtry and Trent Railway and Dock Bill, Elham Valley Light Railway, Limehouse Subway (Extension of Time), London, Brighton, and South Coast Railway, Regent's Canal City and Docks Railway, Worcester and Broom Railway, Alexandra (Newport and South Wales) Docks and Railway, Liverpool Tramways, Charing Cross and Waterloo Electric Railway (Abandonment), Lynton Railway, Plymouth, Devonport, and South-Western Junction Railway, Wrexham and Ellesmere Railway, London and Blackwall Railway, Great Northern (Various Powers).

Going to the final stage, the following among other Bills have received the Royal Assent:—Skipton and Kettlewell Railway (Abandonment), Port Glasgow Harbour, Blackburn Water, Rickmansworth and Uxbridge Valley Water, Tilbury and Gravesend Tunnel Junction Railway (Abandonment); Ashton, Stalybridge, and Dukinfield Waterworks; London, Chatham, and Dover Railway (Capital); Oxford Waterworks, East and West India Dock Company, North Metropolitan Tramways, Waterford, Dungarvan, and Lismore Railway Extension (Abandonment), East Surrey Water.

AN ACCOUNT OF SOME PRELIMINARY EXPERIMENTS WITH BIRAM'S ANEMOMETERS ATTACHED TO KITE STRINGS OR WIRES.*

THESE experiments were regularly commenced in September, 1883, and continued at intervals up to June 14th, 1884. A preliminary note descriptive of the apparatus and method employed appeared in the "Quarterly Journal" of the Royal Meteorological Society in 1883. As, however, some improvements have since then been made in the mode of flying and estimating the heights, it may be as well to give a brief account of the scheme *de novo*.

First of all, two kites are flown tandem, the upper one being a small kite about 4ft. high, which is easily got up, and which, when it has reached an altitude of about 100ft., where the wind is always considerably stronger than at the earth's surface, is used to lift up the larger main kite—7ft. high—which bears the string—latterly wire—to which the instruments are fastened. It also helps to keep the latter steady when up, and prevent any sudden and dangerous descent of kites and instruments. The larger kite is now made of tussore silk of the diamond pattern, and capable of folding up like Archer's patent portable kites. The tail, which is in reality a most important adjunct, and usually the first part of the apparatus to give way, is made of six large wire-rimmed canvas cones fastened to a swivel, which allows them to revolve without twisting their cord.

In the first experiments the main kite was flown with a strong flax cord, but latterly, at a suggestion by Sir William Thomson, piano-cord steel wire has been used similar to that employed in Sir William's deep-sea sounder. This I have found a great improvement on the string. It is double the strength, one-fourth the weight, one-tenth the section, and one-half the cost, the only drawback being that, unless great care be exercised, it is very liable to kink and rust. To obviate the latter I have got my supply for the coming year electro-plated.

It is also necessary to have wire all through, otherwise a disagreeable discharge of electricity is apt to take place at the junction of the wire and string in ordinary weather, a fact to which some of my friends would be able to testify. When the wire is continuous, and in contact with the iron of the winder, which is rivetted to the ground, I have found no perceptible shock in ordinary weather. The winder was made for me by Messrs. Elliott Bros., and though by no means perfect, is capable of being rivetted to the earth so as to hold the kite in a powerful wind, and being furnished with a ratchet and spring catch, can be locked so as to allow me to attend to the anemometers, take observations with the theodolite, &c. The anemometers are of the ordinary Biram pattern, 6in. in diameter, and suspended to a gun-metal rod so as to swing in the vertical plane of the wire, the rod being fastened to the wire by clamps at its ends. When the large kite is about 100ft. or so from the winder, and steady, an anemometer is fastened to the nearest 100ft. mark, and its indication and the time noted. The wire is then paid out a certain distance, and another anemometer attached, and so on, the interval between the lowest instrument and the winder being regulated by whether the differences of velocity are required for a comparatively high or low altitude respectively. The altitudes are measured by taking the vertical angles of the instruments every ten minutes with a theodolite placed at the winder, and combining their average value for the whole period with the lengths up to each instrument. The method employed is necessarily approximate, as I cannot leave the winder very well and take simultaneous observations at the ends of a base line. It is, however, one which I have reason to believe to be very fairly accurate. A certain allowance for curvature is made up to the lowest instrument. The arc between the two instruments is then taken to be approximately equal to its chord, and from this and the vertical angles the chord to the highest instrument is calculated, and thence its vertical height. This method has occasionally been checked by observations taken at the ends of a base of 891ft., and with such satisfactory results, that in the present case, where the observations being relative, great accuracy in measuring the absolute heights is not required, I have decided to adopt it in preference to the latter infinitely more cumbrous method.

Numerous observations have been made without success, accidents of all kinds happening both to kites and instruments, sufficient to deter anyone who was not imbued with a little faith that all would eventually come right. I have therefore only been able so far to collect the results of a select few, viz., 23 in all, in which the conditions were favourable.

Hitherto I have only used kites as a *point d'appui* for observations on the differential velocity of the air at different heights, a purpose for which they are obviously exceptionally fitted. I am hoping, however, during the coming year, with new and improved apparatus and assistance, for which I have received a Government grant, to employ the same means of elevation for observations of temperature, pressure, height of cloud-strata, &c.

Anemometer Observations on Kite-Wire.

Date and time of day. 1883.	Instrument.	Height in feet. H	Velocity in feet per minute. V	Time in minutes. T	True direction of wind. D
Sept. 8 4.53 p.m.	B	278	1561	98	N. 22° W.
	A	77	989	82	
Sept. 10 12.25 p.m.	A	257	1542	106	S. 8° E.
	B	160	1352	85	
Oct. 6 3.59 p.m.	B	425	1177	121	N. 7° E.
	A	178	833	109	
Oct. 20 3.29 p.m.	B	380	1163	75	N. 85° W.
	A	146	882	59	
Oct. 20 5.12 p.m.	A	217	1209	34	N. 85° W.
	B	98	864	25	
Oct. 24 4.12 p.m.	B	230	1907	25	S. 82° W.
	A	110	1248	19	
Nov. 10 12.31 p.m.	A	383	1771	130	N. 48° W.
	B	138	1499	109	
Nov. 10 3.1 p.m.	B	405	1791	114	N. 75° W.
	A	148	1539	102	
1884					
Feb. 16 4.42 p.m.	A	232	2079	26	S. 38° E.
	B	107	1638	20	
Feb. 23 4.31 p.m.	B	430	2534	90	S. 37° W.
	A	294	2441	85	
Feb. 27 5.26 p.m.	A	130	1147	56	S. 53° E.
	B	40	746	45	
March 8 5.13 p.m.	B	270	1392	73	S. 49° W.
	A	88	1012	37	
March 15 4.50 p.m.	B	268	1632	103	S. 48° E.
	A	79	1119	89	
March 19 4.44 p.m.	A	433	1518	62	S. 52° W.
	B	215	1234	53	
March 20 3.14 p.m.	B	344	2384	79	S. 87° W.
	A	167	2016	66	
April 2 5.49 p.m.	A	446	1639	78	S. 23° E.
	B	212	1165	68	
April 4 3.34 p.m.	B	430	2202	101	S. 44° E.
	A	228	1916	79	
May 14 3.13 p.m.	D	422	2038	112	S. 38° W.
	C	292	1936	99	
	B	185	1904	90	
May 26 2.58 p.m.	B	495	1994	69	N. 77° E.
	D	207	1879	59	
May 29 3.44 p.m.	D	646	1769	98	S. 64° E.
	B	310	1648	90	
May 30 3.38 p.m.	B	631	2102	97	N. 37° E.
	D	329	2025	88	
May 30 5 p.m.	D	643	2039	87	N. 35° E.
	B	334	1987	78	
June 14 11.5 a.m.	A	618	2040	52	N. 1° E.
	C	324	1950	38	

The height of the place of observation is 500ft. above sea-level. Of course it is not intended at this early stage to attempt to draw any but the most temporary conclusions from such sparse data. There is no doubt that if observations could be taken every hour a distinct diurnal variation in the difference between the velocity at two given heights would be observed, the velocity at the greater altitude probably tending towards a minimum about the same time that the velocity at the earth's surface reached its maximum. This would, however, only be found to be the case when the heights were about 1000ft. or more. Apart from actual determination by help of the instruments, however the existence of such a diurnal variation has been several times forcibly brought to my notice by the fact that while during the middle of the day the kite frequently flies with great difficulty owing to the presence of vertical ascending and descending currents, towards evening, when the wind at the surface has often died away altogether, the kite flies at a higher altitude and pulls harder and steadier than it did during the day. This has so often occurred that I have ceased noting it as anything extraordinary. I may observe that such a condition is precisely what one would expect if the theory of the diurnal variation in the velocity of the surface wind given by Dr. Köppen in the *Zeitschrift der Oesterreichschen Gesellschaft für Meteorologies* for 1879, be accepted. According to this theory the expansion of the lower strata by solar action during the day causes an intermixture of the air—*luft austausch*—to take place between the upper and lower layers, by which the velocity of the lower layers is increased by the greater velocity which the descending air brings with it from above, while the upper layers have their velocity decreased by the smaller velocity with which the ascending lower air retarded by the asperities of the earth's surface is endowed. Thus while the mean velocity of the atmosphere might remain about the same, the differences between the velocities above and below should undergo a diurnal period, the minimum difference occurring somewhat after mid-day. I was glad to see the other day that some observations on the velocity of the wind at some lofty observatory—I think Pike's Peak—showed that the diurnal period in the wind velocity at 8000ft. or 9000ft., in exact opposition to what occurs at the earth's surface, exhibited a minimum about mid-day.*

Another feature that has been brought out by observing the flight of my kites, which frequently fly at heights of from 1300ft. to 1500ft. above the sea and thus enter the clouds, is the existence of a *courant ascendant* under cumulus and cumulostratus clouds. When such a cloud comes over, the kite rises up until the string is at an angle of 60 deg. or more; but in proportion as it rises, so its pull becomes weak; the kite in fact lies on its face, and thus losing nearly all the horizontal component, the curvature of the string increases very much, and if an instrument is attached to it, it is sure to come down. After such a cloud has passed I have frequently noticed the apparent existence of a downward current which causes the kite to descend and at the same time increase its pull by the pressure being exerted more against a vertical surface.

Regarding the observations themselves, I am not aware that any similar ones have previously been made, except by Mr. Stevenson, of Scotland. His plan was to fix anemometers to a pole 50ft. high or place them at different heights up a mountain. In the latter case it is not certain that the velocities represent what would occur in the free atmosphere at the same level. In the former, one is limited to poles of moderate height, and I do not at present see that anything else can compete with a kite wire for greater heights; balloons, captive or otherwise, being of course out of the question where wind is concerned. Mr. Stevenson seems finally to have adopted a very simple formula for the increase of the velocity with the height, viz., that it is exactly proportional, or $\frac{V}{v} = \frac{H}{h}$. That though this might be true up to 50ft., it is certainly not true for greater heights I showed pretty conclusively in *Nature* for March 29th, 1883,—page 506—where a discussion of Dr. Vettin's cloud observations favoured the formula $\frac{V}{v} = \left(\frac{H}{h}\right)^{\frac{1}{4}}$ through a range of more than 20,000ft.

Though I do not wish to try and determine any formula at this preliminary stage, it may be interesting to note the exponent yielded by the observations I have made, when grouped together roughly according to altitude. The results are:—

No. of obs.	Mean upper height	Mean lower height	Mean upper velocity	Mean lower velocity	Approximate value of exponent in formula
6	249	93	1630	1145	$\frac{1}{4}$
8	412	173	1751	1474	$\frac{1}{5}$
4	634	324	1987	1902	$\frac{1}{16}$

Thus, while the velocity invariably increases as we ascend, the rate rapidly diminishes after the first 200ft. or 300ft. It must, however, be remembered that the place of observation is itself 500ft. above sea-level, and though this would probably not affect the results near the surface, the air above 200ft. must be moving with very nearly the same velocity as it would have at its real elevation above a sea-level surface. Adding therefore the 500ft. to both heights in the case of the two last groups, we get, for the value of x, $\frac{1}{3}$ and $\frac{1}{4}$ instead of $\frac{1}{5}$ and $\frac{1}{16}$. These two values are probably nearer the truth than those in the table, and hover round the mean value $\frac{1}{4}$, which I have already stated was found to hold for Vettin's cloud velocities up to 25,000ft. In any case it is plain that Mr. Stevenson's formula cannot be taken to hold beyond his 50ft. pole.

Further observations will, I trust, give a trustworthy basis for determining the variations in the velocity-increment corresponding to the direction and absolute velocity of the wind as well as those corresponding to season, humidity, temperature, and pressure. To thoroughly investigate the velocity-increment under all such conditions, and thus to afford data to the physicist who desires to construct the hitherto unwritten science of aërodynamics, will be one of the objects of my experiments during the coming year.

P.S. October 22nd.—Since the forgoing observations were made I have succeeded in getting readings with the anemometers at heights of over 1100ft. above the ground, or 1600ft. above sea-level.

* Paper read at the Montreal meeting of the British Association by Professor E. Douglas Archibald.

* This seems also to be the case on Ben Nevis, regarding which M Buchan says, "In each of the months the maximum velocity is during the *night*, and the minimum during the *day*, being thus the reverse of what occurs at low levels and on plains"—*vide* "Journal" of the Scottish Meteorological Society, 3rd series, No. 1, p. 17.

THE TILBURY DEEP-WATER DOCKS.

ON Wednesday last the Society of Engineers visited the Tilbury Deep-water Docks which are being constructed for the East and West India Dock Company by Messrs. Lucas and Aird, under Messrs. Manning and Baines, the engineers of the undertaking. The visitors were conducted in two parties over these very extensive works, and those who had previously seen them were able to form some idea of the rapid progress that has been made. The works are in many respects unique, and their size may be gathered from the fact that although there are considerably over 4000 men at work they nowhere appear numerous, and that the machinery plant includes no less than 280 engines of different kinds, many of which are locomotives, hauling the spoil from the great excavations to spoil banks along the low shores of the river, and carrying materials to the places where they are being used. Over forty miles of temporary railway are laid within the 320 acres of land comprising the dock site for the purposes of the work. The Society dined in the Guildhall Tavern in the evening.

An account of the Tilbury Docks will be found in THE ENGINEER of the 3rd of April, 1885, and of the large pumping machinery for emptying the graving docks in THE ENGINEER, vol. lviii., p. 452.

BOILER OF THE STEAMSHIP EASTWOOD.

ON page 477 we illustrate the boiler of the steamship Eastwood, constructed by Earle's Shipbuilding Company, Hull, to supply steam to triple expansion engines, which we shall illustrate in a succeeding impression. Our engraving explains itself.

FIFTY-HORSE HORIZONTAL ENGINE.

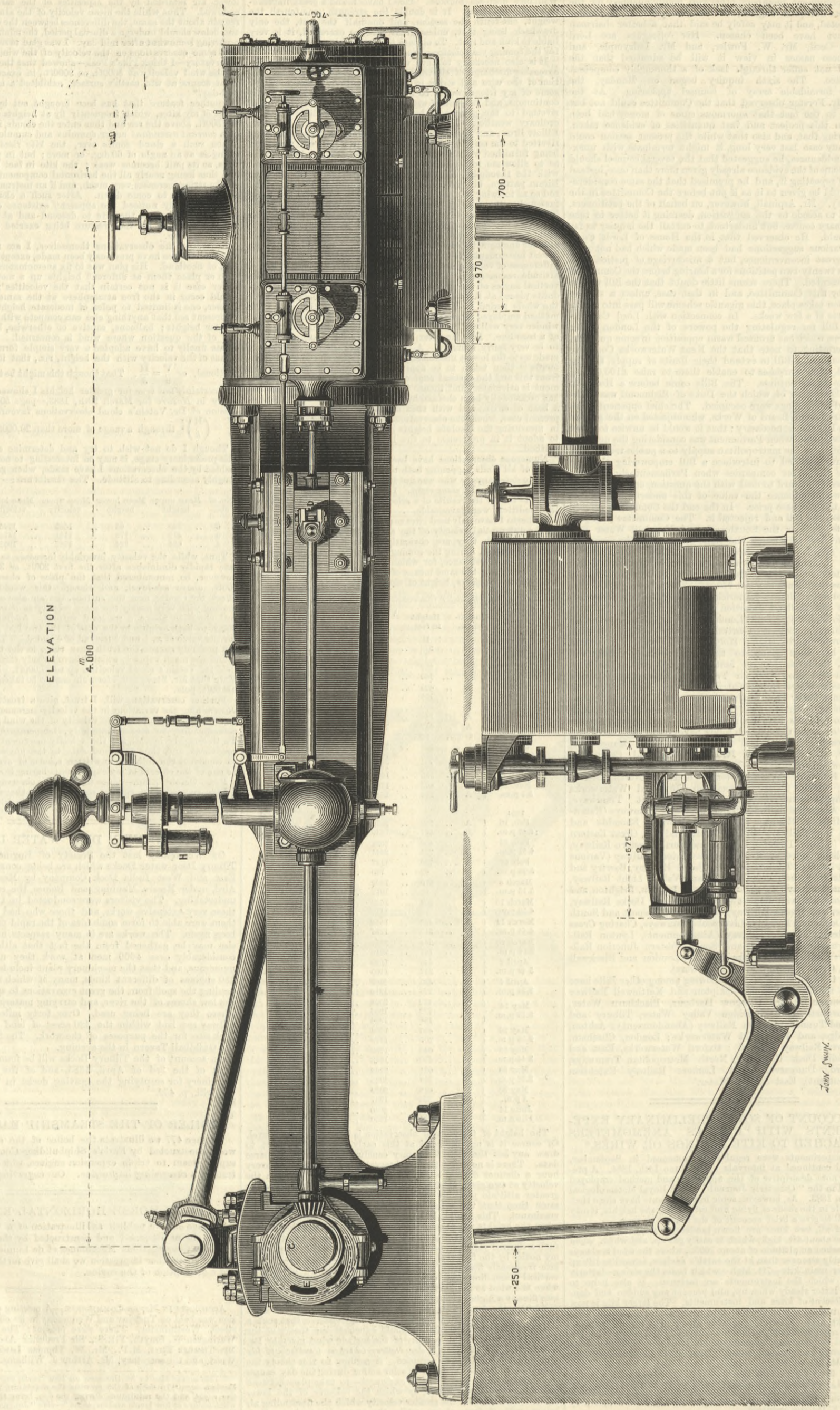
ON page 480 we publish an illustration of a fifty-horse horizontal engine designed and constructed by the Société Lyonnaise des Constructions Mécaniques et de Lumière Electrique à Paris. In another impression we shall give further illustrations and a description of the engine.

ACCIDENTS IN MINES COMMISSION.—A meeting of this Commission was held on Tuesday and Wednesday at its offices, 2, Victoria-street, Westminster. There were present: The Chairman, Mr. Warington W. Smyth, F.R.S., Sir Frederick Abel, C.B., F.R.S., Mr. Thomas Burt, M.P., Mr. W. Thomas Lewis, Mr. Lindsay Wood, and the secretary, Mr. Arthur J. Williams.

50-HORSE POWER HORIZONTAL ENGINE.

CONSTRUCTED BY THE SOCIÉTÉ LYONNAISE, PARIS.

(For description see page 479.)



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CHILLED CASTINGS (Q. R.)—*See* THE ENGINEER *24th December*, 1880, *and 7th January*, 1881.

F. W. R. (Troy, N.Y.)—*We have not heard of any apparatus being regularly used for testing the friction of slide valves.*

S. S. (Darlington).—*There is no rule regarding minimum curves; everything depends on the speed, the gauge, and the type of engine. Thus, the double-bogie Fairlie engine will get safely round curves which could not be traversed by an ordinary engine. In Germany the sharpest curve allowed on a passenger line for the* 4*ft.* 8½*in. gauge has a radius of* 600*ft. Curves of three chains radius,* 4*ft.* 8½*in. gauge, are common enough on various mountain lines, and as little as* 2½ *chains is not by any means unknown.*

POLISHING PEBBLES.

(*To the Editor of The Engineer.*)

SIR,—Can any reader tell me something of the method and machinery used for cutting and polishing pebbles and geological specimens? D.
June 15th.

THE BLOCK SYSTEM.

(*To the Editor of The Engineer.*)

SIR,—Can any of your numerous readers inform me who was the original inventor of the empty or block section of signalling, known as the block system, adopted on most railways in this country and abroad? A. B. R.

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

DEATH.

On Friday, the 12th of June, at 3, Great Stuart-street, Edinburgh, aged 52, FLEEMING JENKIN, LL.D., F.R.S.L. and E., M.I.C.E., of Stowting Court, Kent, Professor of Civil Engineering in the University of Edinburgh.

THE ENGINEER.

JUNE 19, 1885.

THE PROPOSED SCHOOL OF FORESTRY.

ON several occasions we have commented upon the reports received from experts appointed to conduct inquiry into the subject of forestry in our colonial dominions; and when doing so we took the occasion to advert to the almost singular position occupied by Great Britain among European nations in the absence of any school under its auspices wherein study of this important matter might be pursued. It seemed strange that a country like our own, possessing as it does throughout its colonial empire almost the largest forests in the world, should so long have left itself without the means of providing the trained men who can alone be capable of efficiently dealing with their preservation and control. Indeed, among Englishmen, accustomed hitherto to draw their supplies of timber from abroad, there has been a negligence in this respect which we rejoice to perceive is as the result of recent discussion in the House of Commons, no longer likely to continue. Most of us will have in memory the ignorant outcry raised in Parliament when what appeared to be a ruthless thinning out of the trees in Kensington Gardens took place some two years back. The denunciation that course met with evidenced most strongly how little alive the generality of English people were to the conditions which govern tree-life. It seemed to have been the common opinion that once a tree has struck its roots, no matter under what condition as to space or air afforded to it, its future growth might be left solely to the operations of nature. That power, however, readily asserts itself; and the same laws which govern the results of overcrowding among a human population apply themselves with equal force to tree-life.

The ignorance which the case above cited proved to exist in these islands has not yet, we fear, been generally removed. We find that the appointment of a Commission to further the establishment of a School of Forestry in England has its aims and intentions greatly misunderstood. "Why," we have heard it asked, "cannot Kew undertake all that is required? The men of science there are well-fitted to advise on all matters of arboriculture as well as to those relating to horticulture or floriculture, and there can, therefore, be no reason to suppose that we are behind other nations in this respect." It is impossible to conceive a more crass ignorance of the bearings of the question than this and similar remarks we have heard made evince. There are a thousand and one considerations, apart from those of a merely cultural character, which enter into the policy of technical education in forestry. Those of our readers who bear in mind Mr. Vincent's report on the forests of Ceylon, with which we but lately dealt, will appreciate fully the varied nature of these. The economic side of the subject cannot be grasped save by those who have studied the markets of the world, and learned by that study when and where it may be productive of loss or profit to plant trees of certain descriptions, or to supersede natural growths by those of an imported character. For in these days it does not suffice to regard forestry as an abstract science alone; it must be studied with reference to that law of supply and demand the fulfilment of which can alone produce a remunerative result, either present or prospective, to the conservation of our forests.

Perhaps among the foremost of the evils which Ireland had to suffer in former generations was the practically complete denudation of the land of those magnificent forests with which some of the mountains of that country were once clothed. Neglect of those economic laws—the recognition of the value of which we trust to see a British School of Forestry secure—has produced results in Ireland towards which many of our finest colonies are rapidly tending. Efforts have been made, it is true, in most of them to stay the progress of devastation; but it will not be until the study of forestry as a science has secured its due recognition among the English people, as evidenced by means for a study of it in their midst, that those efforts are likely to secure that co-operation which alone can ensure their success. It is certainly a striking anomaly in the position which Great Britain holds that hitherto all the men trained for the Indian Forest Department should have been obliged to pursue their preliminary studies in the forest schools of Germany, France, or Switzerland. That anomaly is the more striking because, when a student leaves these schools for practical work in India or the Colonies, he finds the conditions under which he has to carry out his duties wholly different from those which govern the pursuit of forestry in European countries. The economical conditions referred to above, the effect of climate, the concentration of rainfall, all are subjects the operation of which he finds to be completely reversed in his new sphere of action, and we believe it to be the complaint of many of the men sent out to our distant possessions, after a course of study in the continental schools, that they have as much to unlearn as they have yet to acquire.

We would impress upon the Commission to which the details of the proposed establishment are confided the necessity for giving the fullest prominence to this fact. It will not do for them, as representing in their function an empire which embraces the world's surface, to rely too fully upon the course of study in the Continental schools as their model, neither will it in any way meet the needs of the case to entrust teaching to men whose experience has been restricted to their curriculum. All will, indeed, depend upon the selection of the men who are to form the instructing staff. Their experience should be as varied as are the localities with the treatment of which they will be called upon to deal. The forester trained in Canada will in no complete way be fitted to instruct men destined for Indian, or, we will say, tropical charges generally; while the economic training adapted for an English forester would lead astray the man destined for colonial service. Not only must the teaching staff be varied in its experience, but it must be subdivided into the several branches with which a forester should become acquainted. A timber surveyor and an arboriculturist rolled into one will not yield the class of man we want. He must be far more than this, and, with the expectation of obtaining what is required, let us express the hope that it shall be secured that the career of a thoroughly efficient forester shall offer prizes worthy the endeavour of our best educated classes to secure them.

BACKLASH IN GEARING.

EVERYONE who has much to do with machinery is familiar with backlash; but very little has been written concerning the cause of it, or the means of getting rid of it. Indeed, direct and palpable mistakes concerning it have been made by authors who ought to have known better. For instance, Rankine defines backlash thus: "The excess of the space between the teeth of one wheel above the thickness of the teeth of another wheel with which the first wheel gears, is called play, or backlash, because it is the distance through which the pitch line of the driver moves after having its motion reversed before the backs of the teeth begin to act." This is very imperfect and inadequate. Unfortunately, the jarring and rattling of teeth, known as backlash by millwrights, is certainly not the clearance space between two teeth; nor is it met with only when wheels are reversed. If two cogged wheels properly made, be run together with a steady pressure there will be no backlash, and there will be very little noise. The cause of backlash is simply that the pressure is not uniform, and the cure of backlash can only be effected by making it uniform. The old millwright's rule, that the velocity of the rim of a fly-wheel must be in excess of that of the circumference of the millstones, went right to the root of the whole matter; and we propose to show here in a few words what are the special means to be adopted to get rid of backlash. Whether they can be applied in practice or not depends in all cases on conditions over which the engineer sometimes has, and sometimes has not, control.

No matter how heavy the fly-wheel of an engine may be, it never revolves with a uniform velocity. Its speed falls off as the crank approaches the dead point, and the dead point being passed, it gradually augments until mid stroke or some point near it has been attained by the piston. If the machinery driven is so light that it has not much momentum, then its speed will rise and fall with that of the engine, and there will be no backlash. If, on the contrary, the driven machinery has a good deal of weight and momentum, then there is certain to be backlash. Let us suppose, for example, that a fly-wheel 15ft. in diameter, and weighing 10 tons, makes fifty revolutions per minute. The average speed of the wheel rim will be 2355ft. per minute. Let us further assume that the maximum velocity of the wheel is 2360ft. and its minimum velocity is 2350ft. per minute. Let the rim of the wheel be toothed, and let it gear into a wheel 5ft. in diameter, weighing 1 ton; the speed of this wheel will be identical with that of the fly-wheel, and its momentum will be too small to help the fly-wheel in any way over the dead point. Its momentum, indeed, will be only one-tenth of that of the fly-wheel. Now, let us suppose that the machinery driven is run under these conditions at a speed too irregular for the required purpose, say, spinning cotton, and that to get over this difficulty the millowner mounts a second fly-wheel 15ft. in diameter on the second motion shaft. The rim velocity of this wheel will be three times that of the fly-wheel, or 7065ft., and as the controlling power of fly-wheels varies as the squares of their velocities, this second wheel will have nine times the steadying power of the first wheel, instead of only one-tenth of it, as was the case with the spur wheel alone. What, then, happens is that whenever the main fly-wheel tends to lag behind, the second motion wheel takes up the running, and the spur wheel on the second motion shaft will actually run faster than the fly-wheel, and will drag it, the pressure being transferred from the front of the teeth to the back, and the play existing between the teeth will permit them to hammer each other, and so backlash will be set up. The velocity of the second spur wheel will not tend to vary much over 1ft. per minute, while the velocity of the main fly-wheel tends to vary, as we have seen, 10ft. per minute, and the toothed spur wheel will therefore alternately drive and be driven twice in each revolution. As far as the spinning machinery is concerned, the result may be satisfactory enough, but the backlash will be intolerable. The teeth will be worn out of shape and broken. We have here, of course, a purely imaginary case, the conditions being worse than those which are usually met with in practice; but this is the best way to put an elementary truth, so that it may be readily understood by those who have not much knowledge of the theory of machines. The second fly-wheel is seldom used out of ironworks, but the equivalent of a second fly-wheel is by no means unknown. Thus we meet with long lay shafts fitted with numerous heavy spur wheels, running at a high speed, and these are often quite adequate, especially when the load is light, to drag the fly-wheel after them twice in each revolution. When the load is heavy in proportion to the momentum of these secondary revolving masses, the backlash will be small or absent; and this is the reason that, as is well known, gearing will sometimes run with noise and tremour enough to shake a mill down, while at others it is quite quiet. In one case the load is light, in another it is heavy. Broadly stated, all revolving masses on second motion shafts which tend to help a fly-wheel to equalise velocity are liable to cause backlash in spur gearing. The way to avoid backlash lies in taking measures to prevent the load driven running away from the driver.

There are, moreover, other causes which tend to the same end. A fruitful source of trouble is want of balance in some part of the machinery. Some years ago a horizontal engine, indicating about 50-horse power, was put down to drive a corn mill. From the first this engine, which worked expansively, gave trouble in the way of backlash. After much talking and thinking, the manager of the firm by whom the engine was made suspected that the fly-wheel was out of balance. The wheel was unkeyed and swung, and this was found to be the case—probably from an imperfection in the casting; and to make matters worse, the wheel was so hung as to aggravate the want of balance, retarding the wheel when the crank was near one dead point. About 2 cwt. of balance weights were cast and bolted to the rim, when the backlash at once disappeared and no further trouble was experienced. It may seem that the means adopted were quite inadequate to the end; but it must not be forgotten that the difference between silence and noisy backlash is often very small. A very little hanging back of the fly-wheel of an engine may suffice to take the cog faces away from each other for a moment, and these, coming together again, will make quite as much noise as is desirable. One other cause of backlash deserves notice, and that is the whipping of long shafts. An instance came under our notice some years ago where two rows of 3ft. 8in. burr stones, fifteen pairs in each row, were driven by two lay shafts, each over 90ft. long. Fine flour could not be made with the stones furthest from the engine, because each shaft whipped nearly one-sixth of a revolution, being too small in diameter for its work. It will be seen that if a weak shaft is interposed between a driving spur wheel and a load, we have all the elements of unequal stresses between the teeth of the gearing at once introduced. It must not be supposed that backlash is confined to cog wheels; in some cases much trouble is experienced in driving with ropes, because the second-motion pulley is so heavy that it helps the fly-wheel of an expansive engine. The result is that the ropes surge up and down, and may be thrown off. Rope gearing has been used for driving tilt hammers in Wales and elsewhere, but with unsatisfactory results, due to the sudden flying forward of the rope pulleys when the helve trips off the wiper. It may not be out of place to add

here that the heavier the fly-wheel, and the more expansively the engine is worked, the greater is the probability that there will be backlash. It is a favourite notion with some engineers that a fly-wheel cannot be too heavy. The truth is, however, that the wheel should always bear some definite ratio to the weight of the other revolving masses whose momentum tends to render motion uniform. To put once more an imaginary case, let us suppose that on the shaft of an engine two fly-wheels of equal weight were mounted, the one keyed on the engine shaft and fitted with spur gearing, the other mounted loose and driven from the shaft by a coiled spring or some such flexible arrangement. It requires no great familiarity with mechanics to see that the second, or loose wheel, would soon set up a kind of rythmical apparent motion with regard to the first, the spring would alternately coil and uncoil as the second wheel was alternately driven by and helped to drive the first wheel; and it is also clear that the lighter either of the wheels was the more closely would their rates of motion of rotation coincide.

We sometimes hear it said that wheels are running with a great deal of backlash, when there is nothing of the kind. There is a tremendous noise, it is true; but this is due to the bad form or condition of the teeth, and to nothing else. Wheels out of truth on their shafts, or with considerable play in the shaft bearings, cannot run silently; and it should never be forgotten that when a wheel has been properly pitched and trimmed to run with another, if that other gets broken it cannot be properly replaced by the first wheel of the same pitch that the mill-owner can lay hands on. Certain firms, we may add, make the production of gearing a speciality; and our readers will find it cheapest in the long run to resort to such firms rather than go to any one who happens to have a set of wheel patterns handy. Second-rate gearing is the most expensive commodity any millowner can use.

PROGRESS OF THE GAS SUPPLY.

MR. JOHN FIELD continues his useful "Analysis" of the accounts of the metropolitan, suburban, and provincial gas undertakings. Going back to the earliest of Mr. Field's annual records, we meet with a striking example of metropolitan growth. In 1869 the London gas companies sold considerably less than 10,000,000 thousand cubic feet of gas, whereas last year the thousands of cubic feet exceeded 21,000,000. Thus the consumption of gas has increased at a rate greatly exceeding the growth of the population. In 1869 London paid for gas little more than £2,000,000, whereas the sum paid last year was £3,105,000. Accordingly the gas supply has more than doubled, while the total cost to the consumer has not increased much more than one-half. Gas has become cheaper, and the consumption has been encouraged. There is a feature for consideration in the fact that the gas sold per ton of coal carbonised was 8438 cubic feet in 1869, whereas the quantity per ton last year was 9597 cubic feet. Hence it appears that a ton of coal is made to furnish the consumer with 1159 more cubic feet now than it did fifteen years ago. Some of this advance may be due to greater economy in the mode of distribution, the waste of gas *in transitu* having been diminished in recent years. In 1874 the waste was nearly 9 per cent. of the total make. In 1884 this loss was reduced to little more than 5 per cent. In 1869 the average price paid for gas in London exceeded 4s. 1d. per 1000ft. This has now dropped to rather less than 2s. 11d. In the range of fifteen years the capital of the London gas companies has risen from £7,829,000 to £13,814,000. Coal last year cost nearly £1,500,000. In 1869 the coal account was nearly £1,000,000. The cost at the earlier date was a little under 16s. 4d. per ton. Last year the average price per ton was 13s. 5d. The profit on gas has fallen from something under 1s. 7d. per 1000ft. to a little more than 1s. 3d. Taking all charges into account, the net profit on gas has fallen from 1s. 4½d. per 1000ft. to less than 1s. 2d., a diminution which looks considerable; but the net profit on the share capital raised has increased from 10 to 11 per cent. Residuals bring in fully twopence per 1000ft. more at the later date than at the earlier. The gross profit on the gas manufacture in London last year was £1,343,011. Deducting interest on borrowed monies, this became £1,210,653. The standard dividends took £1,011,292, and the additional dividends under the sliding scale took £191,473, leaving a surplus of £7888. The reserve funds of the London Gas Companies, together with the unappropriated balance of profit, amount to £974,879, in addition to £179,555 for insurance and other funds.

The entire gas manufacture of the metropolis is carried on by three companies, of which the Chartered takes the lead, followed by the South Metropolitan and the Commercial. Fringing the metropolis there are fourteen gas companies, of which Woolwich has two. Putting all these fourteen together, their operations shrink into insignificance compared with the leviathans of London. The capital employed by the whole suburban force is under 2¼ millions, while the South Metropolitan alone makes use of £2,335,000, and the Chartered employs £10,733,000. But the suburban companies are making progress, their year's increase of gas sold being 7·46 per cent., thus excelling the London companies, who only increased their sale by 3·47 per cent. As a matter of course, gas is dearer on the smaller scale, the rental of the suburban companies averaging 3s. 4d. per 1000ft., or fivepence more than in London. The highest figure is at Colney Hatch, where the gas rental is 5s. per 1000ft. Gas is nearly as dear at Lea Bridge, and the lowest price we meet with is in the case of the Woolwich Equitable Company. Brentford has much the largest rental of the fourteen, but charges rather above the average if we exclude the lighting and repairing of public lamps. The provincial companies of which Mr. Field takes account are ten in number, and the corporations eight. The former have raised £5,045,000 of capital, and the latter £6,552,000. The companies have increased their sale of gas by more than 5 per cent. in quantity during the year, and the corporations by less than that amount. Omitting the cost of lighting and repairing the public lamps, the gas rental of the companies is slightly less per 1000ft. than that of the corporations, each verging on half-a-crown. It will be understood that we are only taking a few of the leading figures furnished by Mr. Field. The "Analysis" is a very extensive affair, and will repay a careful study. It is admirably worked out, and must have cost an enormous amount of labour. It certainly shows no abatement in the progress of the gas interest, however severe may be the rivalry of the electric light in future years.

PRIVATE WAGON RISKS.

WHEN the Midland Railway Company initiated the policy of purchasing the wagons of private owners, some people questioned the expediency of the step on the ground that the company was simply relieving colliery owners of old trucks which they would replace with new. The Midland, they said, was imitating the Aladdin policy by offering new lamps for old. The illustration was scarcely a happy one, for the "Arabian Nights Entertainments" furnish no more brilliant financial transaction than that by which the Evil Genii gained Aladdin's wonderful lamp. It was not likely that the company would purchase any kind of wagon without regard to its condition or capacity for running, and the most casual observer who travels much by rail has no difficulty in perceiving that "M. R.," the mystic initials so well known England over, are becoming more common in every siding, and the monograms and names of private owners are getting scarcer. We are informed that the number of wagons acquired by the Midland has now reached eight figures, which practically means that they are quietly acquiring something like a monopoly of the wagon business. But the change means more than that—it means greater immunity from accidents, and consequently increased safety for the travelling public and decreased danger of accident and repair expenses for the company. Indeed, at one large station of the Midland, the other day, where there has been no serious mishap for a long time, the inspector for the district was asked by his men to give something towards a raffle. He said he was at a loss what to give, when one slyly suggested that he might give the breakdown van, as its occupation appeared to be gone. Other companies, and notably the Midland's neighbour, the Manchester, Sheffield, and Lincolnshire Railway, have suffered severely from the failure of private wagons. It was the breakdown of a private owner's wagon which caused the terrible disaster on New Year's Day at Penistone; and only last Friday, within a mile or two of the same place, the drawbar of another private wagon dropped, and caused the line to be blocked for a couple of hours. The company has stringent regulations to govern the running of these trucks, but the greatest care is sometimes of no avail, and the danger of running wagons which are not constantly under the keen eyes of the railway officials is admittedly greater than that pertaining to the use of vehicles which are subject to ceaseless vigilance and condemned the moment they show signs of unworthiness. Coal companies in these hard times may look askance at wagon builders' bills, and be disposed to delay rebuilding dangerously long, in the hope that the turn of trade may bring them better times for spending. They would be more than human if they did not diminish expenditure to the lowest possible point, and it is just precisely at this point that the peril begins.

THE RICHMOND WATER SUPPLY.

"THE scientific nonsense of the past few years" has, according to one of the speakers at a select vestry meeting at Richmond last week, been "thrown overboard" by the Water Committee of that town. Another vestryman, "acquainted with the scientific world," was pleased that this had been done, especially as some of the committee seemed to be disposed to attach value to the opinion of an engineer whose name this widely acquainted vestryman not only did not know but considered peculiar. Perhaps the peculiarity not only consisted in its not having been before met with by this vestryman, but in Mr. Schonheyder's unfortunate loss of his acquaintance. Whether the scientific world has neglected this Richmond vestryman, or whether the latter has special reasons for conferring the advantages of his acquaintance on a few only, does not appear, but this would seem to be the case, as he opposed the proposals of a number of people, including the resident engineer, and lauded in terms that Barnum would have considered puffing a firm whose name he did not consider peculiar. However, in spite of the difficulties which the "acquaintance with the scientific world" imposed, the Richmond Committee last week came to the conclusion that certain proposals made by the resident engineer, Mr. W. G. Peirce, should be adopted. This is a scheme to acquire deep well pumps to put into what is known as the original Artesian Well, and to hire temporarily a pumping engine for testing this source, in preference to the other more costly schemes which he also described. The lowest possible depth reached by present pumps in what is known as the Dummy Well is 136ft. below the surface of the ground, the ordinary pumping level maintained being about 134ft. The supply of water increases for every corresponding additional foot in depth. In his report, Mr. Peirce says—"This increased supply of water can only be obtained by placing a pump in the Artesian Well. By this arrangement the deep-well water can be raised into the Dummy Well, and from the Dummy Well to the Service Reservoir—by two lifts—thus considerably relieving your present pumps in the Dummy Well, and this will, I believe, prove a most economical undertaking, and will at the same time provide the increased supply of well water necessary for the service of the town. I would particularly recommend this scheme, as it would aid you greatly in sinking a new well, or deepening the Dummy Well, by lowering the water level—when pumping—and it would make the sinking a new well or deepening the Dummy Well a comparatively easy undertaking. I beg also to call attention to the well-known fact that the water level in the London basin is annually subsiding, which necessitates the lowering of pumps generally, in order to maintain an uniform supply of water. The water level in the London basin is stated to have been sinking at the rate of 1ft. per annum for some years past. My estimate for this work is £800." The Committee passed this estimate, and gave orders that the money be procured for the purpose.

THE INCREASE IN MERCHANT SHIPPING.

IN the returns of shipping and shipbuilding which have been officially issued for the past year we have some facts showing the growth of the merchant shipping of the Empire, but pointing also to the fact that the rate of that growth has been very remarkably checked. In the year 1880 the tonnage of the registered vessels owned in the British Empire was 8,447,171, and in the next year 128,389 tons were added to that amount. The year 1882 added 220,000 tons in round numbers, and the year 1883 saw the large addition of 354,000 tons. Last year witnessed a further addition, but one much smaller—an addition of 183,078 tons. Thus the total of the vessels owned at the end of last year was 9,314,496 tons for the whole of our Empire. It is certain that in the present year there has been no increase; indeed, in some months there has been an actual decrease, and thus the total last stated may be given as the total for the Empire now. One fact is remarkable, that the increase in the tonnage of the four years is not very great in proportion to the whole fleet; it is under 900,000 tons, but the significant fact not shown in the totals is that the whole of the increase last year was in steamships, and thus the power of work was greater than appears in the totals of the tonnage. But in the present year the reverse is the case. We are losing more steamers than we are building, and we are increasing the tonnage of the sailing vessels, so that slowly but surely the merchant shipping of the Empire is contracting its working power in concurrence with the contraction of the trade of the world. Should that trade begin to expand—of which there seems some indication—there will be a much more rapid equipoise attained between the supply and demand in the carrying trades. It is to the attainment of that equipoise that the owners of steamships must look for the recovery of their trade, but one of the facts that come out in the perusal of the official records to which we have thus drawn attention is that there is a slow but gradual change in the position of the merchant shipping fleet. It is not cheering because of the decrease but it is because of the improvement in the future that it will bring to the shipping trade, and because the merchant fleet can be speedily increased if needed.

THE PAVING OF THE NEW LONDON STREET.

OF the reasons which have induced the Metropolitan Board of Works to commence paving the street in course of formation from Oxford-street to Charing Cross with stone we are altogether uninformed. They should be very strong to justify the Board in inflicting upon the people of London a nuisance which has been condemned and removed from all our leading thoroughfares. It may be justly anticipated, we think, that the traffic which will follow this new route when opened will be such as soon to lead to the occupation of its frontages by shops of a high class; but those who might seek to establish these will certainly be strongly impelled to abstain from doing so if the noise and dust of a stone pavement are to be expected. We have had it in evidence that the tradesmen of Oxford-street have found their stocks of goods remain undeteriorated for a much longer time since the wood pavement was laid down than was the case during the days of that of stone. Similarly, foot passengers will make of a quiet street a lounge well calculated to increase trade; but they will avoid that as far as possible where the din of vehicular traffic prevents conversation with a companion or jars the nerves of a solitary individual. If, therefore, the Board of Works hopes to secure a good class of occupants for the shops to line their new street, and consequently a remunerative letting for their vacant land, it is taking the very step to militate against the realisation of that hope. It has been proved over and over again that the life of a stone pavement under heavy London traffic is shorter than that of wood, and we fail altogether to realise what can have led to the committal of the preliminary error pointed out.

BERTHON BOATS.

ON Thursday, June 11th, a trial of a new description of Berthon boat took place at Romsey. The vessel in question is what is termed duplex, being made up of two separate boats, each the shape that would be arrived at by cutting a boat transversely amidships, and providing flat ends to each half. This is on the principle of the regular Berthon duplex boat. The peculiarity of this particular boat is that it is adapted specially to the conveyance of guns and horses, being 39ft. long, 13ft. wide, and 4ft. 6in. mean depth. We have before described the Berthon collapsing system, which is indeed well known. To describe it again briefly we may say that the boat consists of wooden longitudinal timbers, and double canvas bottom and sides. The longitudinal ribs consist of the gunwale, and two, or three, or four timbers beneath, which are linked together at the bows and stern, and can be opened out or closed flat on the same principle as a circular Chinese paper lantern. The object of this construction, speaking of the boats generally, not specially of the horse vessel, is to supply a craft which can be carried flat to the ship's side, and which can be opened in the act of lowering so as to form a very serviceable double-bottomed boat. The canvas under some conditions must be more easily torn open than wood, but as the timbers are deep, their webs constitute complete divisions, the principle of compartments is carried out to a considerable extent, and the air between the sides gives the property of a lifeboat, since this air is not displaced if the boat fills with water. Probably the leading object to be fulfilled by the Berthon boats is the supply to vessels carrying passengers of boats partaking to a great extent of the character of lifeboats which can be folded close to the ship's side, and are therefore easily carried.

The Royal Navy have had one pattern of Berthon boat for about eleven years. They are still serviceable, we are informed, but naturally they do not embody in themselves the more recent improvements. The Union Company, the South-Western Railway screw steamboats, and the Jersey boats also carry them, and more recently the Italian Government have been ordering them, and they have been supplied to our own torpedo boats as well as to the Inflexible and other ships. The horse boat will shut up to a width of 2ft., and the others of course to a much less compass. In the case of a vessel firing very heavy guns, the folding has the great advantage of preserving the boat from being blown to pieces by the rush of gas. At Alexandria a Berthon boat was actually hung in the place where an ordinary boat had been thus destroyed, and the former remained without suffering injury from subsequent firing.

As we have more than once illustrated the Berthon system, we now only give three small figures, showing the general principle on which the boats open and collapse. It may be seen that if the boat hangs from rings on the line A, Fig. 1, if the lever bars used to press the boat open are removed, it will naturally collapse, but the weight has only to be taken by rings on the line B, and the boat by its own weight opens. The boat is hung on the ship's side by rings at A, and as it is swung out it is lifted by a ring at B, the men jump into it, and the whole is fixed and stiffened by pressing home levers, which are hinged on the timbers, so as to hold from timber to timber. The wood employed is Canada rock elm. In most cases each

timber is made of several thicknesses bolted together, like the springs of carriages, so as to give the bend and elasticity required. A special paint is used, to prevent liability to come off if kept folded or collapsed for a long time. The amount of air held between the sides of the boats may be estimated from the fact that the large one, whose dimensions we have given above, and with which we are now dealing more particularly, takes in about 300 cubic feet as it opens. The holes for the ingress and escape of air are high up in the ends at bow and stern.

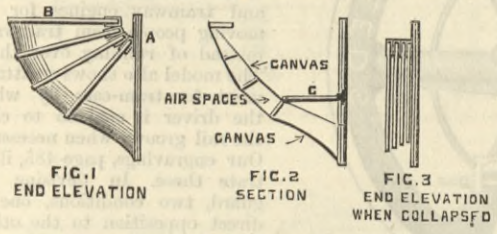


FIG.1 END ELEVATION — FIG.2 SECTION — FIG.3 END ELEVATION WHEN COLLAPSED

It will be seen that the bottom, Fig. 2, is hinged at its junction with the timber and also along its centre—*i.e.*, in the line of the keel—and when the boat collapses the centre rises, and so shuts up in the space where there are no timbers to interfere with it. Thus, the only pieces that do not close up are any extra ones put in when the boat is in use, such as skidding to take heavy weights. The large boat for horses and guns has only a gunwale, second and third timbers, and keel. Others have more timbers, according to their requirements. Of course a boat with fine lines to be well shaped requires more timber than a tub. It thus loses in floating power, but gains in number of compartments. The halves of the duplex boats are united by bringing together and bolting the flat ends to each other. The details are not worth giving; indeed, we do not think them as good as they might be.

To take in guns and horses, the gunwale on one side can be let down and a "brow" placed from the land to the boat's bottom. This brow requires very little arching, but is made to alter its angle by wedges, according to requirements. The process of taking horses in and out is therefore a very simple one. Mr. Berthon had a dummy gun and carriage weighing 1¼ tons, and a limber weighing 1 ton. The latter he ventured to place on two small boats, each 12ft. long, which carried it and displayed great buoyancy. We may remark, by the way, that it was a rash experiment; the platform was unnecessarily high, and the weight, which consisted chiefly of half-hundred weights, in the limber-box was placed so high that if these short boats had capsized we should have laid no stress upon it. The experiment showed buoyancy, but could show nothing more.

Six horses were led on board the large boat by means of the brow over the starboard gunwale without the least difficulty. Sixty volunteers then followed, after which the gunwale was raised, and the boat pushed off. The draught of water when the boat was loaded with 10½ tons was 17in., and when lightened of the cargo about 6in., consequently she was immersed rather over 1in. per ton of cargo. The boat weighs somewhat over two tons—that is, each half weighs rather over one ton—and it is estimated that it would carry a load of about twenty tons; and Mr. Berthon considers that it bears the concussion and recoil of discharge of a gun better than any other kind of boat. He proposes to fire a 4½-ton gun on it.

Altogether we report confidently on these boats. Speaking of the Berthon boat as a whole, it has the following recommendations:—It offers a means of carrying boats enough to hold the entire crew and passengers of the most crowded ship, and these boats possess the qualities of lifeboats in a great measure—that is to say, they have air enclosed in compartments in the manner above described. The objection that might naturally arise on the supposition of the boats being fragile is abundantly met, we think, by the fact that those that have been supplied to the Navy are after eleven years serviceable, and likely to continue so as far as we can learn. Yet anyone with experience in such matters will know that experimental stores give extra trouble, and hence it is very difficult to ensure them fair treatment—from subordinates especially. There is abundant evidence that the Berthon boat meets a real want, and its use on a large scale is a mere question of time.

FLEEMING JENKIN.

THE death of Professor Henry Charles Fleeming Jenkin, on Friday, 12th inst., leaves a gap in the engineering profession which probably cannot be filled with anything like the same brilliance as attended the life that has just ended. Professor Jenkin's health during this last winter had not been so vigorous as usual, and no doubt he suffered from a series of domestic bereavements, which only recently followed each other with terrible rapidity. Still he exhibited his characteristic activity and spirit in carrying out his work until a week before his death, when a surgical operation of comparatively slight importance had to be performed. Death resulted from blood poisoning which occurred during or after this operation.

Professor Jenkin was born in 1833 in Stowting Court, Kent. His father, Captain C. Jenkin, R.N., died only last spring. His school education was obtained at Jedburgh and Edinburgh Academies, at Frankfurt-am-Main, and at Paris, at which latter place he was during the revolution of 1848. He took the M.A. degree at Genoa, and afterwards served an apprenticeship in a locomotive shop at Marseilles. A second apprenticeship was served at Fairbairn's in Manchester lasting three years, from 1851 to 1854. He was then employed successively by Mr. Hemans, on a survey in Switzerland; by Messrs. Penn, Greenwich; by Messrs. Liddell and Gordon, on railway work; and by Messrs. Newall, Birkenhead, where he commenced his work in connection with cables. His early experience was thus of the most varied kind, and no doubt tended towards the development and accentuation of those racy and versatile characteristics that made him so charming a member of society, and so inspiriting a teacher of a subject that is sometimes considered dry and dreary. Soon after his apprenticeship he was engaged in the manufacture and testing of the first Atlantic telegraph cable. He accompanied many cable-laying expeditions as chief electrical engineer during the voyage, some of these being in the Mediterranean, and the most important across the Atlantic to Brazil in in 1873. It has been in cable testing that his greatest practical triumphs have been achieved, and in this special line he for long maintained an unrivalled position as colleague of Sir Wm. Thompson. Since about 1860 there has been between him and Sir William a close connection in work and friendship; and we understand that it was greatly owing to Sir William's kindly encouragement and assistance in early years that Mr. Jenkin's brilliant talents became first widely recognised and directed towards such practical scientific work as gave abundant scope and food for their fruitful growth. He was elected Assoc. Inst. C.E. in 1859, and was in 1868 made a member of the Institution. In 1865 he became an F.R.S., and in 1866 was appointed Professor of Civil and Mechanical Engineering in University College, London. He had also become a partner with Mr. H. C. Forde in an engineering firm in London, which business connection he kept up from 1861 to 1868. He held the appointment at Gower-street for three years only, resigning it on his election to the similar chair in Edinburgh University. This chair was then—1868—newly founded by help of the munificence of Sir David Baxter, of Dundee. It has been worthily occupied by Professor Jenkin since then until his death. He had free scope to develope his own school of engineering, untrammelled by traditions or restrictions handed down from predecessors. Thoroughly acquainted as he was with both the practical details and the scientific principles of actual work, he recognised the real needs of professional training, and adopted a method of teaching that was thoroughly original and well calculated to direct the students' observation to the imperative influence of ever varying practical circumstances on the problems of design. He held up to well-deserved ridicule those pseudo-engineers who think it scientific to pretend by long arrays of decimal figures to an accuracy which does not really exist in the very nature of their calculations. He avoided the pernicious formality, the book pedantry, the copy-making narrow-mindedness of South Kensingtonism. He taught that books were reservoirs of information from which nothing useful can be fished out except by the help of intelligence wherewith the reader must discriminate for himself the good from the bad. Especially he declined to crush out the intellect from his pupils by overloading their memories by an all too heavy load of formulæ. He never despised the utility of formulæ, but he maintained that their proper place was in the reference note-book, not in the memory. His class examinations were conducted in accordance with this principle. Each student was allowed to bring with him into the examination-room as many books, printed or manuscript, as he liked, with full liberty to refer to them as much as he chose. No student, however, was allowed to borrow from another during the examination any book whatever; each must depend entirely on the resources he had chosen to provide himself with. It is hardly needful to say that many a student who came up panting under the load of a long armful of books went away from the examination without having succeeded in making any profitable use of a single one of them; having very possibly wasted much precious time in a fruitless search for what he ought to have been able to lay his finger on at a moment's notice, or, perhaps, in copying out paragraphs totally irrelevant to the question at issue, and earning for him zero marks by affording easy and infallible proof of his want of comprehension. The "copying" from the printed text book could never fail to be detected at sight by the critical eye of the master. One of the secrets of the professor's success as a teacher was that he made a point of cultivating friendly relations between himself and his pupils. Many Saturdays were devoted to excursions to engineering works and factories, occasionally in somewhat distant parts of the country. Before starting on the excursion there would be a students' breakfast party, at which Mrs. Jenkin would usually preside, and which was made enjoyable to even the "gawkiest" of the race of student by her and her husband's genial grace and good humour. It is a hard task to make a set of Scotch lads merry when under the eye of authority, and presumably on their good behaviour. But the difficult problem was not unfrequently solved at that hospitable breakfast table.

Again, Professor Jenkin took an interest in his pupils not only during the years in which they were in his college classes, but also throughout their after career; and there must be many of these who now look back with great gratitude to many acts of kindness they have received at his hands since they have entered on the struggle of practical life. Professor R. H. Smith, of Mason College, Birmingham, and Professor J. A. Ewing, of Dundee College, are among those who owe their college training to Professor Jenkin. He was made an LL.D. by Glasgow University in 1883. He acted as juror at several exhibitions, among them the Paris, 1878, and the Health Exhibition of 1884.

With his professional enthusiasm he combined a great love of art, especially of dramatic art. At the conclusion of nearly every college session there was carried out in his house a short series of private theatricals. These were got up with immense care and labour and at no little expense, and the acting on this private stage was so genuinely good that these *réunions* came to be famous in Edinburgh society, and to be looked forward to as one of the best treats of the season. The mechanical genius of the host had contrived that the end wall of his dining-room should be almost wholly removable, although nothing suspicious could be detected about this apparently solid wall when the room was being devoted to its ordinary uses. When thrown down, this partition discovered an ample stage behind it. Two other rooms in his house it may not be indiscreet to mention here. The one was his study, packed on every side with books and instruments, and next to it a small workshop, well equipped with tools, and in which his son has built very creditable "real live" boilers and engines under the personal superintendence of his father. The extraordinary versatility and agility of his mind is well illustrated by the fact that once in the middle of one of these dramatic performances before a large and fashionable audience, when it happened to be the writer's duty to warn him that his cue was approaching and that in a minute or two he would be "wanted" on the stage, he was found in his study in theatrical costume rapidly correcting proof sheets of his book on "Magnetism and Electricity." Among other amusing talents he preserved to his last days the power of speaking fluently in very broad Scotch with a Lowland intonation, the exactitude of which could only be fully appreciated by a thorough-bred native.

Of his literary and scientific work the "Text-book on Electricity and Magnetism" has already been mentioned and still remains a standard book for students, having reached a seventh edition, and having been translated into other European languages. The treatise on bridges in the new "Encyclopædia Britannica" is from his pen. He did a great deal of the work of the Committee of the British Association that arranged and obtained the general adoption of the present system of electrical units. He carried out an interesting series of experiments upon the variation of coefficient of friction with velocity in journal friction. He was appointed secretary of this committee and wrote most of their reports. Last year he gave a valuable lecture on "Gas and Caloric Engines," to the Institution of Civil Engineers. He also at various times delivered lectures on engineering and technical education, and on sanitation and health, which attracted much attention. The critical acumen of these magazine articles has received very marked acknowledgment by the various authors—Darwin, Mathews, Duncan, Prof. Munro—under review, who in subsequent editions referred gratefully to the value of these criticisms. In one case, and that on a medical subject utterly disconnected with engineering, the critical article from his pen was reprinted *in extenso* in future editions of the book. Other subjects of review were "Trade Unions," "Incidence of Taxes," "Antique Greek Dress," a proposed "School of Dramatic Art."

In conjunction with Mr. J. A. Ewing, he made a most important and extensive series of phonographic investigations into the nature of the various sounds used in speech by the human voice, the actual sound vibrations of the air being autographically reproduced in all their intricacy and with the most beautiful distinctness in curves drawn on paper. In 1877 he started the Sanitary Protection Association of Edinburgh, and from this parent society similar associations have been born and nourished under his fostering care in London, Glasgow, Dundee, and elsewhere, very greatly to the improvement of the sanitary condition of these towns. For some years past he has been engaged in developing the system of electrical transport or haulage which he has christened telpherage. He frequently contributed critical articles to the quarterly and monthly periodicals on the most varied subjects, from the "Origin of Species" to "The Equation to the Law of Supply and Demand," which latter law he endeavoured to illustrate by his favourite graphic methods. He took an early and very considerable part in introducing the now common graphic methods of calculating stresses in bridge and roof work. On this subject he read a valuable paper in 1870 before the Edinburgh Royal Society, and his studies in this direction led him to propose a bridge design, free of flexibility, in which all important members were in tension. In other papers in 1877 and 1878, before the same society, he extended the graphic method to the calculation of the forces through moving machines. These latter papers show the greatest intellectual ingenuity applied in the most useful possible direction, and they are also of very especial importance, in our opinion, because they contain the first indication that occurs in literature of the complete and scientific definition of a *machine* as distinguished from a *mechanism*, the credit of elucidating with completeness the nature of which latter probably belongs to Reuleaux.

In 1859 he married Ann, daughter of Alfred Austin, C.B. His wife and three sons survive him. Two of these sons have already taken distinguished places at Cambridge, and one of them rendered his father valuable and substantial service in developing the "nest gearing" of the telpher locomotives.

In recent years one of the most important inventions of the late Professor Jenkin, and one to which he devoted a great deal of thought and attention, was "telpherage," a system, as is now generally understood, for the transport of goods or passengers by electricity. So far the principle has only been applied to the conveyance of goods. His first patent for this purpose was taken out in April, 1882. In a telpher line strained cables or conductors are used, which serve both to convey the electric energy and to support the load, which is hung from wheels running on the conductors. This road is cut up into sections of equal length, supported on posts with crossheads. At each post or support the electric continuity is broken, and the sections are insulated from each other and from the earth. In this first form the sections were electrically coupled together by movable coupling pieces. The loads are connected together in trains made up to the length of a section of the conductor, and a train passing any of the coupling pieces moves it out of action, and the current then passes from the rail in front of the train through a conductor along the train, the electro-motor of the locomotive being included in the circuit, to the trailing wheel, and thence to the hind rail. In this patent was also included a method of governing the train, and an automatic means of preventing any train from overtaking the one ahead of it. A little later in the same year improvements were made in the method of controlling the speed of the trains and preventing collisions.

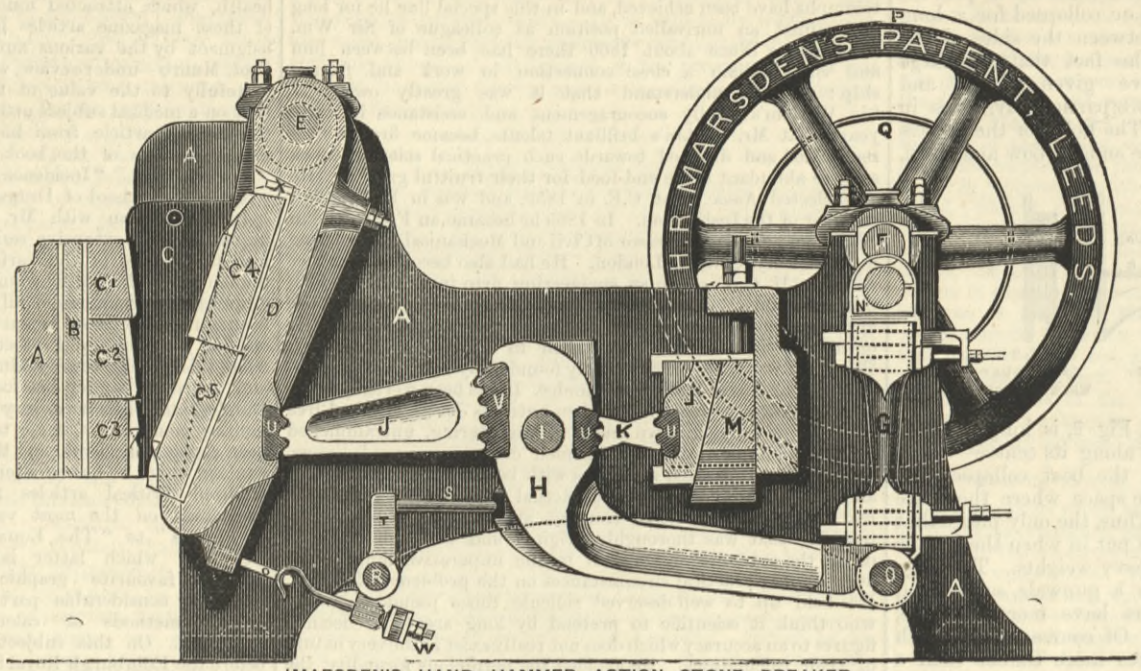
During the year 1883 two experimental telpher lines were erected on the estate of Mr. M. R. Pryor, at Weston, in Herts, and upon these various kinds of locomotives were tried, and also various arrangements of the electrical connections. Four different types of locomotives were devised before a really satisfactory form was produced, and by the end of the year a number of smaller, though important, details were much improved, and the difficulties in the way of properly supporting and insulating the sections of the line were overcome. Early in 1884 the inventor patented some further improvements in locomotives, and the form then arrived at gave excellent results in practical work. Besides the method of electrical connections already mentioned, an arrangement of double path was patented early in 1884. In this a "jockey" or a light truck was used to make contact on the second wire or rod.

The next step in the development of the system was a very good one, and removed all moving parts and switches from the line by an ingenious arrangement of the electrical connections. This is called the cross-over system, as there are cross-over wires at each post head which connect the alternate spans on either side with the intermediate spans on the opposite side, so giving alternating positive and negative sections in the track. This arrangement was the one adopted at Weston, and proved perfectly successful. The trains are supplied with current by this means in a most simple, yet effective, way. Each train is made up to a length a trifle greater than a section, the extra piece enabling it to bridge over from one span to the next, between which is placed a small "dead piece," which is not included in the circuit. The current enters from the one span into the train, passing through the motor and into the second span, as before explained.

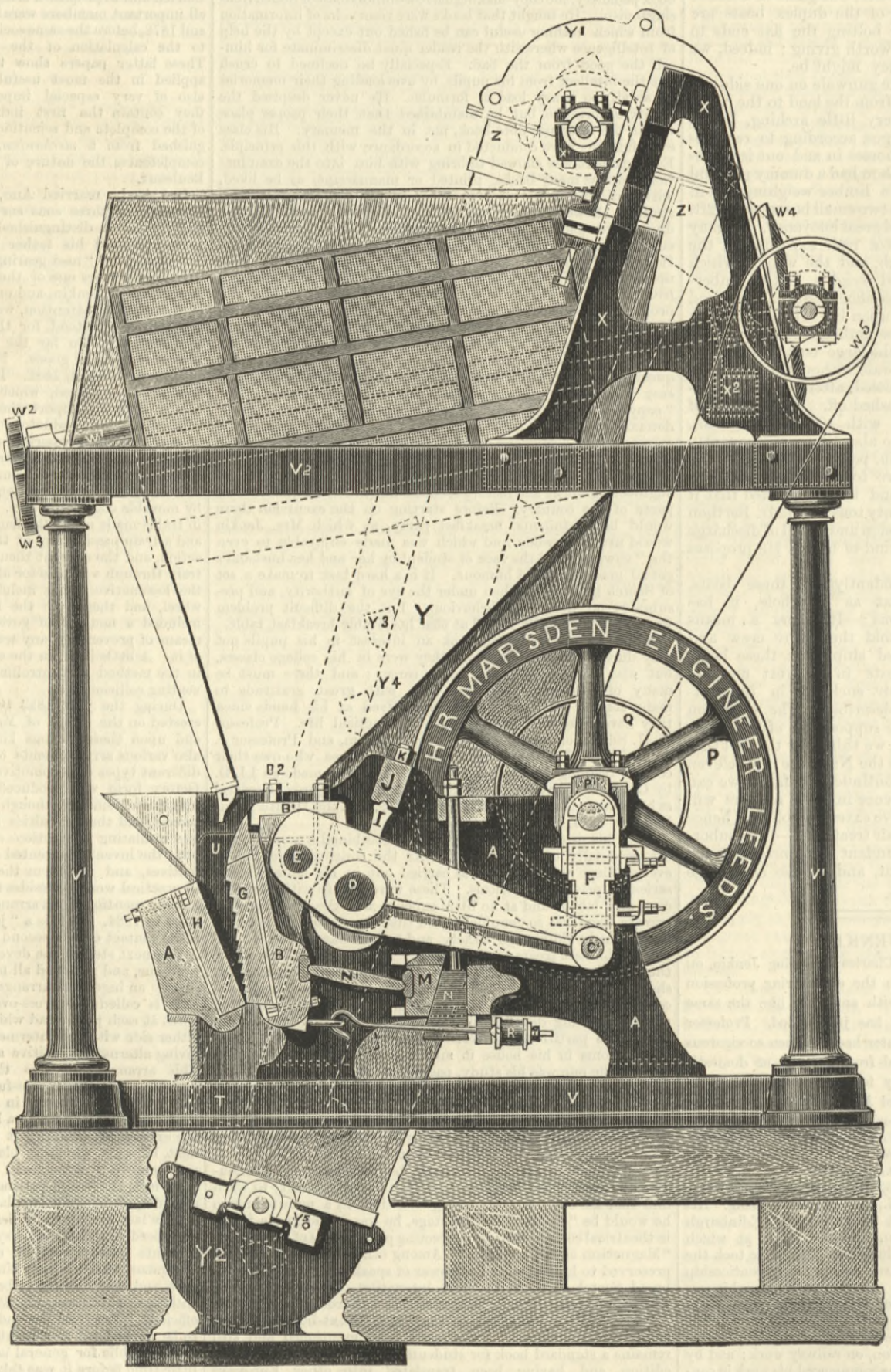
This last arrangement lends itself readily to the addition of an exceedingly ingenious system of automatic blocking, which prevents the possibility of a collision. In this blocking apparatus, which is very simple, there is only one small moving part, and that has not to be touched by the train. It was tried with great success on the Weston line, proving perfectly efficient. Towards the end of 1884 the system was considered to be worked out to a point when it could be confidently offered to the public for general use. It was, however, naturally some little time before it was taken up for practical use, but the first line is now being erected at Glynde, in Sussex. This line is to be one mile long, and capable of delivering 150 tons of clay per week into railway trucks at Glynde Station. The clay is to be thence taken to Newhaven to be converted into Portland cement in the works of the Sussex Portland Cement Company for which the line is being erected, and which has agreed to take it over if it proves satisfactory after some months of actual use

THE INVENTIONS EXHIBITION—MARSDEN'S STONE BREAKERS.

THE stone breaker illustrated by the accompanying engraving is a new type of the well-known machine made by Mr. H. R. Marsden, Leeds, by whom it is, with another machine, exhibited. It is worked in the usual way by a pulley Q upon a crank instead of an excentric shaft. Upon this shaft F a connecting-rod G is attached, and at the other lower end of the connecting-rod is a steel lever, the other end of which is pivotted to the main frame. As the connecting-rod moves up and down it actuates the lever H in such a manner that the toggles J and K give the necessary motion to the swinging jaw D for breaking or crushing the material under treatment. A feature of this machine is the false back B, which is planed and fixed to the frame A itself, against which the three fixed jaw faces, C_1, C_2, C_3, bend, thus avoiding any destructive abrasion between metal surfaces, and providing a means of renewing these faces or reversing their position in a few minutes without the use of white metal for running up. These faces are fitted with surface strips on the backs, so that a dead bearing is easily obtained. The swinging jaw D is planed, and the wearing faces C_4 C_5 of this are fitted in the same manner as the others. A positive drawback motion is imparted to the swing jaw, which entirely dispenses with the old steel embedded india-rubber spring. The frictional parts in this machine have been reduced, and the crank shaft F has been lessened 1in. in diameter in a medium size machine. The new arrangement of the parts has relieved the machine of much of the strain, and the disposition of the lever has, we are informed, greatly reduced the power required. The whole of the shafts and axles are made of hammered steel; the bearings are fitted with brass brushes, and the toggle cushions U and V are all of crucible cast steel. An advantage claimed for this machine is that by altering the position of the teeth of the front toggle J up or down upon the cushion V of the lever, the motion or length of stroke of the jaw can be increased or decreased, and the size of the product thus regulated. The motion obtained by the use of this toothed toggle and lever cushion gives an interrupted movement to the jaw, which is said to make it suit any kind of material, and to prevent clogging. For a certain portion of the revolution of the fly-wheels P the jaw is stationary; the result is a sudden blow by the jaw upon the material, and for this reason the maker calls it the hand hammer action machine. The result is an excellent sample of road metal, and much less waste in chippings. The City of Dublin road contractors assert that the new machine takes 40 per cent. less power to drive than either of four other machines they had in use; that the waste of chippings is 30 to 40 per cent. less, and that the sample of the broken macadam is superior to that broken by hand. They also say that their 4-H.P. engine drives one of the new 15in. by 8in. machines at 250 revolutions per minute, and breaks 6 tons of the hardest diorite whinstone per hour.



MARSDEN'S HAND HAMMER ACTION STONE BREAKER.



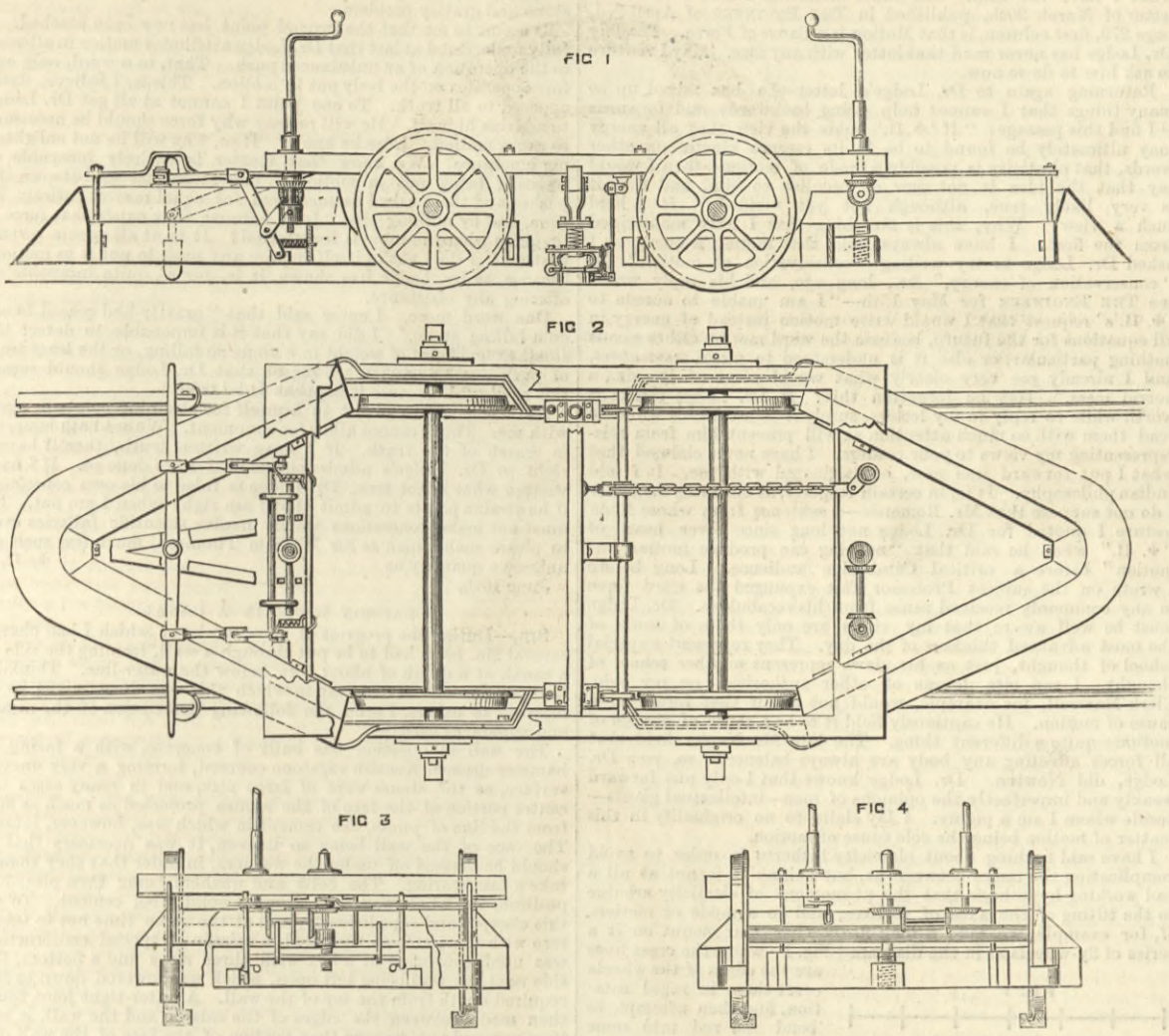
MARSDEN'S STONE CRUSHER, ELEVATOR, AND SCREEN.

The other machine exhibited is a large crusher or pulveriser for reducing material of any degree of hardness to a small size. It follows in principle the Blake-Marsden crusher, but this machine will not allow the material to pass until it is of the fineness required. The connecting rod F, which is attached to the end of the lever C, is actuated by a crank shaft P^1; the lever is pivotted at D, and to the head of the grinding jaw B. The connecting rod lifts the end of the lever, which causes the grinding jaw to have a forward and downward motion of great power upon the material in the mouth between the jaw faces H and G. The material operated upon falls into an elevator at the side, which conveys it to a polygonal screen fixed over the machine, covered with gauze of a mesh according with the fineness of product required. That which is not fine enough passes out at the end of the screen through a small shoot L into the mouth of the machine and is again operated upon with the regular feed. The material in a great measure operates upon itself, thus to some extent avoiding the excessive wear in pulverising. The machine may, however, be worked dry. The new arrangements have improved these well-known machines, though the fact that about six thousand of them are in use would make it appear that improvements were not much called for.

CONRADI'S TRAM-CAR GUARD AND RAIL CLEANER.

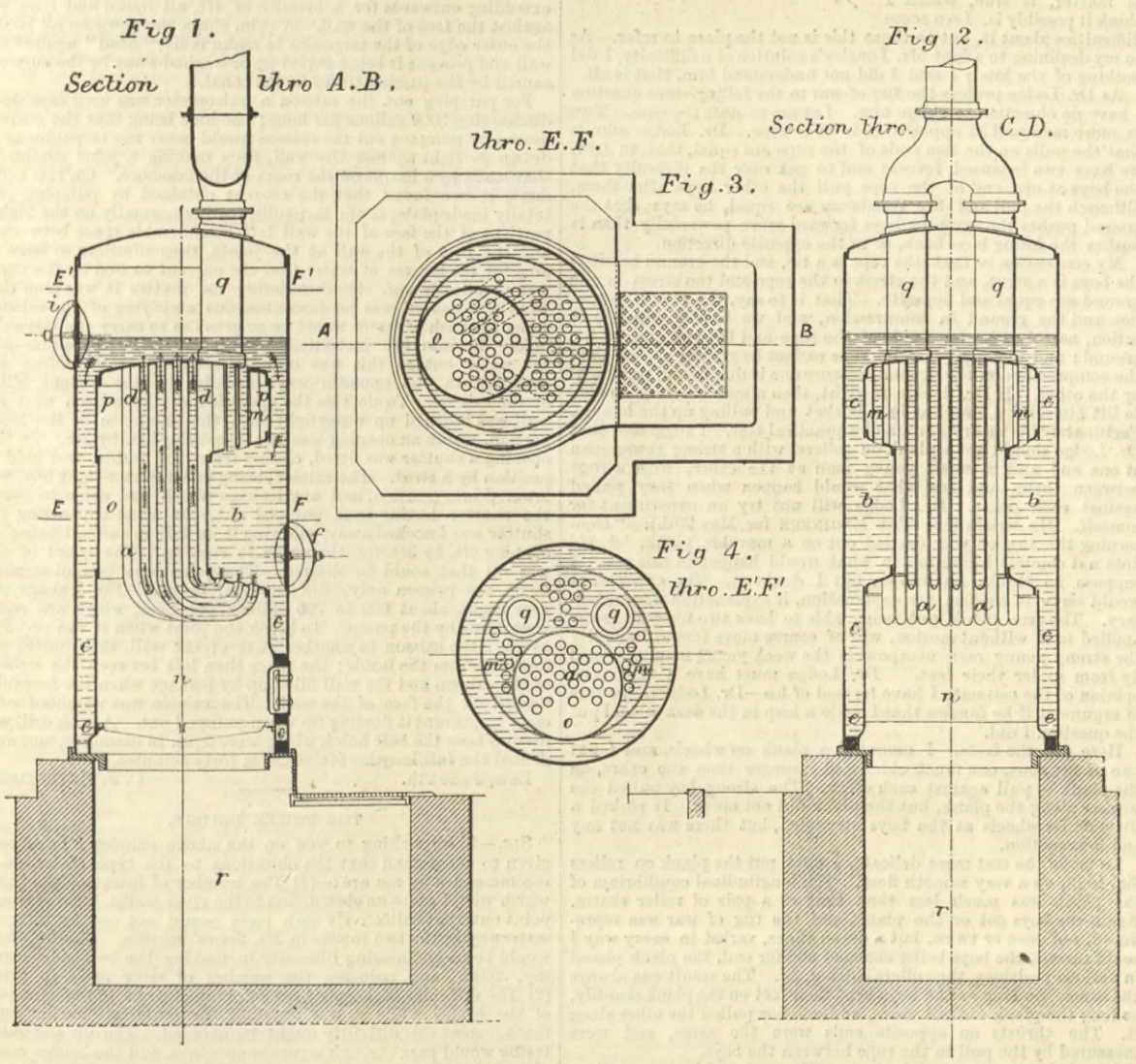
IN the South Gallery, North Court, Inventions Exhibition, a model is shown by Mr. H. Conradi of an attachment for tram-cars and tramway engines for removing people from tramways, instead of running over them. The model also shows an attachment for tram-cars by which the driver is enabled to clear the rail grooves when necessary. Our engravings, page 485, illustrate these. In devising the guard, two conditions, one in direct opposition to the other, had to be observed. The one was to place the guard as near as possible to the rails, to ensure, as far as is practically possible, the safety of limbs and lives of persons fallen on the ground; the other, to keep the guard high enough from the ground to prevent it becoming a rail or road sweeper. From experiment with a stationary elastic guard, Mr. Conradi was led to devise the movable guard illustrated. It is arranged in two ways—either to be rapidly lowered and lifted, or to disengage itself and drop to the ground instantaneously. The elastic cushion or buffer consists of a series of springs, arranged on the principle of elastic mattresses, and covered with india-rubber or other material, to prevent injury to any person when touched and shifted aside by the guard. The shape bears some resemblance to the American cow-catcher of locomotives. The right-hand side of the longitudinal sectional elevation of the plan, and of the cross section of the accompanying engravings, shows the lowering and lifting gear; the guard sliding up and down in its slotted hangers fixed to the frame. The pitch of the screw and corresponding nut are made sufficiently large to traverse the space of 3in. to 4in., by either a half or one revolution. This arrangement has the advantage of being simple and not expensive. This arrangement would meet most requirements, but sometimes a person so suddenly appears before a car and is knocked down, that a driver would have no time to lower the cowcatcher apparatus. To cope with such emergencies the automatic arrangement, as represented on the left-hand side of the engravings, has been devised. The lowering and lifting arrangement is applied as before. The difference, however, is, that in the present case the big nut moves up and down, instead of being stationary. It carries at its right and left a small shaft, upon which hooks A, carrying the guard, engage. As soon as a body touches the elastic projectors or feelers of the guard placed above the rails, the horizontal drawbar is pushed forward. By means of the connecting rods, the vertical levers fixed to it, and carrying the shaft with the hooks, move also forward, and consequently disengage the hooks from their seat. The consequence is that the guard being deprived of its bearings slides instantaneously along its slotted hangers down to the ground, and thus prevents any approach of the body to the wheels of the engine or car. As soon as the danger has passed away the large nut B, with its shaft, which forms the bearing of the hooks, is lowered, and the hooks, in consequence of their inclined position, automatically attach themselves on to the shafts again. They are drawn in position by means of the springs at the bottom of the vertical levers. These levers are fixed at their ends to the guard and swivel round their pivot. The hooks being seated, the guard is again lifted. The rail cleaner already referred to is shown in the centre of the longitudinal sectional elevation, and placed between the wheels so as to keep the scrapers D out of reach of any person, in case of accident. The central main spring provides for the up-and-down motion of the car, as do also to some extent the small leaf springs between the plates. The latter, however, help the scrapers mainly to slide over immovable objects in the groove, as stones

INVENTIONS EXHIBITION—CONRADI'S TRAM CAR GUARD.



hammered in or bad rail joints. Each car is thus enabled to clear its own track. When the grooves have been sufficiently cleaned the scrapers are lifted out of the grooves by means of the lever F and chain connection. All operations are carried out from the platform at the driver's or conductor's stand. The apparatus may, of course, be arranged according to the requirements of the different rolling stock in use, but the general features would remain as here illustrated.

KALASHNIKOFF'S VERTICAL BOILER.



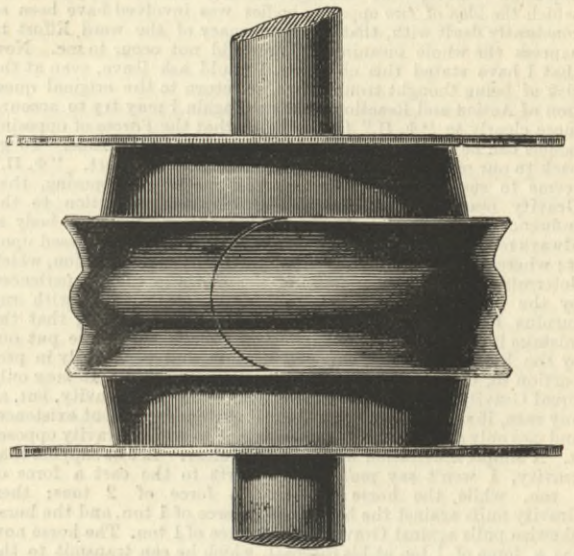
APPLICATION for provisional protection has lately been made by and granted to Mr. E. C. Froom for a new and improved vertical boiler, the invention of Mr. V. J. Kalashnikoff, engineer-in-chief at the shipbuilding yards and works of Messrs. Kourbatoff, in Nijni Novgorod, Russia. The inventor enumerates many new points in this boiler, some of which claim attention. The principal point is that, by the arrangement of the vertical tubes like inverted syphons, the circulation of the water is so rapid and continuous that (1) steam is very rapidly generated; (2) the amount of fuel consumed per horse-power is very small; (3) no sediment can be deposited in the tubes. This latter poin has been established beyond a doubt, as Mr. Kalashnikoff has had an experimental boiler in use for two years in Nijni Novgorod, and sometimes he had to use water with large quantities of lime in it. At the end of the two years not a trace of the lime nor any kind of incrustation was apparent in the tubes.

Another point to be noticed is that by having manholes at f and i, and having movable plates at k and e_1 e_1, all parts of the boiler are easily accessible. The inventor lays stress on his advice to have the ash-pit dug of a sufficient depth to enable the tubes to be taken out through the fire-box into the ashpit without there being any necessity for removing the boiler. This boiler occupies very little space in proportion to its horse-power, and is therefore very suitable for use in confined spaces.

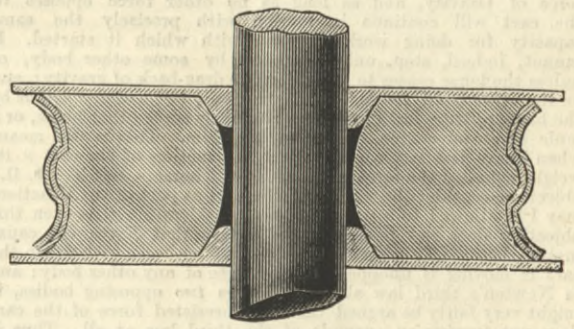
A peculiarity to be noted is the arrangement of the spaces at e e, where all deposit collects in the form of mud. Doors are provided at e e to clear away this mud, but even if this be not done, it makes no difference to the heating capabilities of the boiler, as the work of heating the water is of course mainly done by the tubes. The arrangement of the tubes in the manner shown in Figs. 1 and 2 is the means of producing a very rapid circulation of water in the direction of the arrows; this rapid circulation prevents any incrustation in the tubes. On the other hand, the water in the parts c, c, e and e, being comparatively still, any sediment in the water can fall to the bottom, whence, as above stated, it can be cleared away by means of the doors. Any fuel can be used, from sawdust to coal. The experimental boiler above mentioned, and of which we give the drawings above, is of 20-H.P. nominal. It has been tested with a 20-H.P. high-pressure engine. It has 220 square feet of heating surface, and has driven the engine easily without priming. The fuel used is sawdust, and other waste from a saw mill. Several boilers of this type are in course of construction in Nijni Novgorod.

STERNE'S COMPOUND BUFFER AND DRAW SPRING.

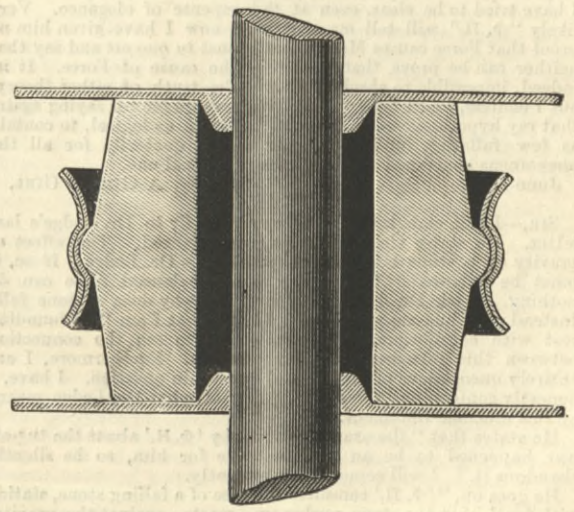
THE annexed engravings illustrate in section a new form of spring specially designed for buffer and draw spring uses, and is a very ingenious combination of rubber and steel. It consists of a rubber block encircled by a corrugated steel belt overlapping at the ends, a combination from which excellent results have been obtained; the resistance of the rubber is increased



about fivefold, while the smooth action of the rubber is retained. The effect of the resistance of the belt increases as the rubber approaches the weakest point thus practically equalising the resistance throughout the entire range of the spring. There is practically no frictional movement of the



rubber within the expanding ring, and the support thus given to the rubber, without friction, reduces the wear and tear upon the most perishable part of the spring. The weight of the rubber employed in this spring is very much less than in any other previous form of the same power, and consequently



renewal is attended with proportionately less expense. The corrugated steel belt being expanded by a uniformly distributed pressure is very durable, and hence the spring, which is made by Messrs. L. Sterne and Co., Glasgow, is offered specially for buffer and draw springs for heavy mineral traffic, and for passenger vehicles fitted with continuous brakes.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending June 13th, 1885:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 8472; mercantile marine, Indian section, and other collections, 2669. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 6 p.m., Museum, 1840; mercantile marine, Indian section, and other collections, 157. Total, 13,138. Average of corresponding week in former years, 16,115. Total from the opening of the Museum, 24,083,610.

LETTERS TO THE EDITOR.

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

THE LAWS OF MOTION.

SIR,—In "Φ. Π.'s" last letter he shows, I think, that he has misunderstood my criticism of his words "Gravity exerts no push upon a body falling freely in vacuo;" and as I should very much regret that so pleasant a correspondence should terminate in a misunderstanding, I have been induced to write yet again. Since reading attentively "Φ. Π.'s" letter I am more than ever impressed with the necessity for accuracy in the use of terms, and in discussing with him I ought, I think, to have been more guarded in my use of the words "Push" and "Pull." Except in the sense of describing *direction of motion*, I do not think they should be used to express the action of a single, unresisted Force upon a body, because, almost unavoidably, they suggest the idea of resistance. Now, I think we are all agreed on one point, namely, that a body cannot resist its own motion.

When, therefore, I spoke of the *Pull* of gravity upon a body falling freely, I meant only to describe the direction of its motion towards the centre of gravity. Not certainly to suggest that gravity had any difficulty in bringing it down. That such was my meaning, is indeed clear, I think, from the latter part of the sentence "only one *unresisted* Force is acting upon it." Then again, "Φ. Π.'s" definition of Force as Effort seems to me too narrow and limited. From my point of view there is no *Effort* unless one Force is resisted by another; this follows, indeed, from the statement that a body cannot of itself resist any Force which is impressed upon it. Effort or strain seems to me to be only one sign, one *measure* of Force, just as motion is another. I feel I must apologise to "Φ. Π." for not having made this objection before, but throughout this controversy cases in which the idea of *two* opposing bodies was involved have been so constantly dealt with, that the inadequacy of the word Effort to express the whole meaning of Force did not occur to me. Now that I have stated this objection, I would ask leave, even at the risk of being thought troublesome, to return to the original question of Action and Reaction, that once again I may try to account more clearly to "Φ. Π." for my belief that the Forces of opposing bodies can be balanced and yet that Motion shall ensue. To go back to our much neglected friends—the horse and cart. "Φ. Π." seems to suppose, or rather to credit me with supposing, that Gravity operates upon the cart exactly in proportion to the influence of the horse; in short, that the weight of a body is always readjusting itself to correspond to the Force impressed upon it; whereas, from my point of view, gravity has a fixed action, which determines, indeed, the amount of the *strain or effort* experienced by the horse, but which has nothing on earth to do with any surplus Force he may possess. I cannot help feeling that the mistake is often made of reasoning as though the Force put out by the horse were solely directed against, and necessarily in proportion to, that exercised by Gravity upon the cart. It *may* only equal Gravity, or it may be a great deal more than Gravity, but, at any rate, it surely has a separate and quite independent existence, and *can* only oppose Gravity to the extent to which Gravity opposes it. A simple illustration will make this clear. Let us suppose that gravity, I won't say *pulls*, but imparts to the cart a force of 1 ton, while the horse possesses a force of 2 tons; then Gravity pulls against the horse with a force of 1 ton, and the horse likewise pulls against Gravity with a force of 1 ton. The horse now has a force of 1 ton at his disposal, which he can transmit to the cart without resistance, for, the pull of Gravity being neutralised, the cart is as much without weight, and can no more oppose the horse's action than if Gravity did not exist. The equivalent of this imparted Force is, I contend, shown in the cart's motion. What the horse has lost the cart has gained. Once set in motion, so long as the horse or anything else continues to neutralise the force of Gravity, and as long as no other force opposes it, the cart will continue in motion with precisely the same capacity for doing work as that with which it started. It cannot, indeed, stop, unless opposed by some other body, or unless the horse ceases to neutralise the drag-back of gravity; and on the other hand, its momentum can only be increased either by the horse putting forth greater force, or by some other horse, or a mule or steam engine, coming to help him. This is all I meant when in my first letter I said that the motion of the cart × its weight equalled the force put forth by the horse. But if "Φ. Π." objects to consider the motion of the cart as part of the Reaction, may I be allowed to suggest for his consideration that even this objection does not invalidate the theory that Force can cause motion, because I am assuming that the 1-ton force with which the cart is moving is unopposed by the force of any other body; and as Newton's third law always supposes *two* opposing bodies, it might very fairly be argued that the unresisted force of the cart does not furnish an example of the third law at all. Thus it might be argued that gravity and the horse having mutually neutralised each other's force, the Action and Reaction in this particular case was completed, and that no fresh instance of the law would be seen until the cart's force was resisted by that of some other body.

I must apologise for the length of this letter, as well as for the very homely and unscientific language in which it is expressed, but I have tried to be clear, even at the expense of elegance. Very likely "Φ. Π." will tell me that even now I have given him no proof that Force causes Motion, but I must *tu quoque* and say that neither can he prove that motion is the cause of Force. It is, indeed, impossible to absolutely prove the truth of either theory, but I confess, and I hope "Φ. Π." will excuse me for saying again, that my hypothesis seems to me to be quite as logical, to contain as few fallacies, and to account as satisfactorily for all the phenomena concerned as his own more original one.

June 17th. A GIRTON GIRL.

SIR,—I will endeavour to reply very briefly to Dr. Lodge's last letter. He states that all forces are balanced. The effect of gravity on a stone is a force, according to Dr. Lodge. If so, it must be balanced. I maintain that a balanced force can do nothing. I ask Dr. Lodge if this be so, why does a stone fall? Instead of telling me why it falls, he says that I am "confounding rest with equilibrium." I entirely fail to see the connection between this statement and my question. Furthermore, I am entirely unconscious of the mental process in question. I have, I honestly confess, not the least inkling of what Dr. Lodge means by this oracular statement.

He states that "the example chosen by 'Φ. H.' about the tug-of-war happened to be an awkward one for him, so he silently abandons it." I will come to this presently.

He goes on, "'Φ. Π.' considers the case of a falling stone, stating with truth that the stone pushes up—reacts—against the gravitation medium just as hard as the gravitation medium pushes it down. . . . There is *only one force* acting on the stone, viz., the push of the gravitation medium, and so of course it falls, being, in fact, pushed down." Permit me to call particular attention to the words I have italicised. They are a flat contradiction of Dr. Lodge's own dictum that an unbalanced force cannot exist, which means, of course, that there is no such thing in nature as an isolated force. If Dr. Lodge does not hold to this—if he now believes in the existence of single forces—there is, of course, no more to be said; there is a fundamental difference between us which cannot be bridged over. It gets rid at one stroke of all Dr. Lodge's difficulties—much as a heap of sand disposes of an ostrich's mental troubles in times of bodily peril.

If, however, we go back a little and take the previous statement—contradicting that I have italicised—that the stone pushes up against gravity just as much as gravity pushes down on it, we have the precise condition for which I have all along contended—namely, a stress, which stress is caused by motion, and is probably, if not certainly, due to the rigidity of the stone; and here I beg to challenge Dr. Lodge to prove that I have ever at any time said "that motion is incompetent to produce strain." This is precisely what I have *not* said. The third definition I laid down in my letter of March 30th, published in THE ENGINEER of April 3rd, page 270, first column, is that Motion is a Cause of Force. Possibly Dr. Lodge has never read that letter with any care. May I venture to ask him to do so now.

Returning again to Dr. Lodge's letter—he has mixed up so many things that I cannot help going backwards and forwards—I find this passage: "If 'Φ. Π.' holds the view that all energy may ultimately be found to be in its essence kinetic—in other words, that elasticity is possibly a mode of motion—then I would say that the idea is not new or peculiar to him, and that it is very likely true, although not yet verified." If I held such a view! Why, this is *the* thing that I have maintained from the first. I have always held that motion is energy. I asked Dr. Lodge to try writing "conservation of motion" for "conservation of energy," &c., long ago, and his reply was—see THE ENGINEER for May 15th—"I am unable to accede to 'Φ. Π.'s' request that I would write motion instead of energy in all equations for the future, because the word motion either means nothing particular, or else it is understood to mean *momentum*, and I already see very clearly what would come of it—viz., a horrid mess." Has he forgotten this? If Dr. Lodge thinks it worth while to reply to my letters, surely it is worth his while to read them with so much attention as will prevent him from misrepresenting my views to your readers. I have never claimed that what I put forward was new, or originated with me. It is old Indian philosophy. It is, in certain respects, as old as Pythagoras. I do not suppose that Mr. Romanes—a sentence from whose Rede lecture I quoted for Dr. Lodge not long since—ever heard of "Φ. Π." when he said that "nothing can produce motion but motion" before a critical Cambridge audience. Long before I wrote on the subject Professor Tait expunged the word force in any commonly received sense from his vocabulary. Dr. Lodge must be well aware that my views are only those of some of the most advanced thinkers of the day. They represent a special school of thought, just as his views represent another school of thought. I can cite dozens of other authorities on my side. Clerk-Maxwell, for example, would not admit that force was a cause of motion. He cautiously held it to be a cause of change of motion—quite a different thing. The late Mr. Napier held that all forces affecting any body are always balanced; so, *pace* Dr. Lodge, did Newton. Dr. Lodge knows that I only put forward weakly and imperfectly the opinions of men—intellectual giants—beside whom I am a pigmy. I lay claim to no originality in this matter of motion being the sole cause of motion.

I have said nothing about elasticity hitherto in order to avoid complicating the issues between us, but I think it is not at all a bad working hypothesis that the phenomena of elasticity are due to the tilting of the axes of vortices, and so a mode of motion. If, for example, we take a long flexible bar and mount on it a series of fly-wheels as in the diagram—Fig. 1—where the cross lines are the edges of the wheels—set these in rapid rotation, and then attempt to bend the rod into some such form as Fig. 2, many phenomena of elasticity can be beautifully reproduced within certain limits, due, of course, to the imperfections of the apparatus. I have had no opportunity as yet of trying the experiment. Indeed, so far as I know such an experimental proof of the theory is now suggested for the first time. Of course, such an explanation of elasticity is barely feasible unless Dr. Lodge's own hypothesis, to which I have already referred, concerning the vortex constitution of matter, is true, which I think it possibly is. I see some difficulties about it, but to these this is not the place to refer. As to my declining to adopt Mr. Lousley's solution of a difficulty, I did nothing of the kind; I said I did not understand him, that is all.

FIG 1

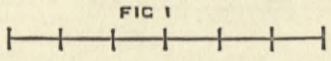
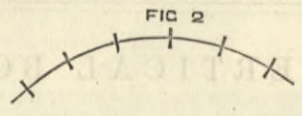


FIG 2



As Dr. Lodge prefers the tug-of-war to the falling-stone question I have no objection to oblige him. Let me re-state the case. Two or more men pull at opposite ends of a rope. Dr. Lodge admits that the pulls on the two ends of the rope are equal, that, in fact, we have two balanced forces; and to get over the difficulty that the boys at one end of the rope pull the other boys after them, although the pull and the resistance are equal, he says that the ground pushes the winning boys forward more powerfully than it pushes the losing boys back, or in the opposite direction.

My contention is that the rope is a tie, and the ground between the boys is a strut, and the stress in the rope and the stress in the ground are equal and opposite. That is to say, the rope is in tension and the ground in compression, and we have four points of action, namely, the two ends of the rope and the two ends of the ground; and the pull on the rope cannot be greater or less than the compression on the ground, because one is due to and measured by the other. If Dr. Lodge is right, then a man ought to be able to lift himself by standing in a bucket and pulling up the handle. Fortunately his theory admits of a practical test. I suggested that Dr. Lodge should set a plank on rollers, with a strong young man at one end and a weak young man at the other, with a rope between them, and see what would happen when they pulled against each other. Dr. Lodge will not try an experiment for himself. He writes (see THE ENGINEER for May 29th):—"Concerning the tug of war carried out on a movable plank, 'Φ. Π.' does not commit himself as to what would happen in this case; I suppose he thinks he knows, but I doubt it. The experiment would serve to confirm my explanation, if explanation were necessary. The free plank, not being able to have two unequal forces applied to it without motion, will of course move forward directly the strong young man overpowers the weak young man, and will fly from under their feet." Dr. Lodge must have a very poor opinion of the estimate I have formed of his—Dr. Lodge's—powers of argument if he fancies that I made a leap in the dark when I put the question I did.

Here are the facts. I mounted a plank on wheels, and I put two of my sons, one much older and stronger than the other, on the plank to pull against each other. The strong boy pulled the weaker along the plank, but the plank did not move. It rocked a little on its wheels as the boys struggled, but there was not any end-long motion.

To make the test more delicate, I next put the plank on rollers 6in. high, on a very smooth floor. The longitudinal equilibrium of the plank was much less than that of a pair of roller skates. Again the boys got on the plank, and the tug of war was reproduced, not once or twice, but a dozen times, varied in every way I could invent, the boys being changed end for end, the plank placed in various positions, the rollers shifted, &c. The result was always the same. So long as the boys kept their feet on the plank steadily, so long the plank did not move, and one boy pulled the other along it. The thrusts on opposite ends were the same, and were measured by the pull in the rope between the boys.

I used the same materials to test the cart-and-horse question. Professor Hudson says that the cart progresses because the ground pushes the horse forward with more force than it pushes the cart back. I made one of my boys play the part of cart by sitting down on the plank, while the other took him by the ankles and drew him along the plank. Still the plank did not move. This experiment I also varied in different ways. Care must be taken, of course, that the standing boy does not lift the sitting boy—that is to say, the pull must be reasonably horizontal, as in the tug of war. This experiment has demonstrated, in the first place, that Dr. Lodge was quite wrong when he said that one boy could shoot the plank from under both; and in the second place, that the notion that the ground pushes one party in the tug of war more than it pushes the other party, is simply a delusion. This being the case, we have balanced pulls and pushes accompanied by motion, which Dr. Lodge and Professor Hudson maintain to be impossible.

Perhaps Dr. Lodge would have done better to have stuck to the stone and gravity problem.

It seems to me that the crucial point has now been reached. I fully understand at last that Dr. Lodge attributes motion in all cases to the operation of an unbalanced push. That, in a word, only one force operates on the body put in motion. This is, I believe, flatly opposed to all truth. To one point I cannot at all get Dr. Lodge to address himself. He will not say why force should be necessary to cause motion. Does he know? If so, why will he not enlighten my ignorance? We know that matter is entirely incapable of resisting being put in motion. The stress set up between the pusher and the pushed is measured for equal masses entirely by time, and by nothing else. Is it because time exists that force is requisite where motion is transferred? It is at all events certain that matter does not in itself require any push to put it in motion, because, as Dr. Lodge has shown, it is, *per se*, quite incapable of offering any resistance.

One word more. I never said that "gravity had ceased to act on a falling stone." I did say that it is impossible to detect the smallest evidence of weight in a stone so falling, or the least trace of push due to gravity. I regret that Dr. Lodge should regard this as absurd, because it happens to be true.

Dr. Lodge takes credit to himself for straining points to agree with me. This I cannot allow for a moment. We are both honestly in search of the truth. If I have written truth, then I have a right to Dr. Lodge's admissions that I have done so. If I have written what is not true, Dr. Lodge is false to his own conscience if he strains points to admit that I am right when I am not. He must not make concessions which involve scientific fallacies even to please such a man as Sir William Thomson, much less such an unknown quantity as Φ. Π.

June 16th.

CAISSON WORK IN A CANAL.

SIR,—During the progress of some works of which I had charge several 2in. bolts had to be put through a wall, forming the side of a canal, at a depth of about 10ft. below the water-line. Thinking that an account of the way in which this was done might be of interest to others, I send the following description of the means and apparatus used:—

The wall in question was built of concrete, with a facing of hammer-dressed Kentish ragstone coursed, forming a very uneven surface, as the stones were of large size, and in many cases the centre portion of the face of the stones projected as much as 6in. from the line of joints, the cement in which was, however, intact. The face of the wall being so uneven, it was necessary that it should be dressed off under the washers, in order that they should take a fair bearing. The bolts and washers being then placed in position, the whole was then grouted solid with cement. To do this cheaply and expeditiously, and at the same time not to interfere with the traffic on the canal, a caisson of special construction was used, consisting of a box with three sides and a bottom, the side next the wall being left open, which was lowered down to the required depth from the top of the wall. A water-tight joint being then made between the edges of the caisson and the wall, it was then pumped out, leaving that portion of the face of the wall dry where it was desired to fix the washers and bolts. The method of making a joint between the caisson and the wall was as follows:—

As before stated, the caisson was similar to a box consisting of three sides and a bottom. Its dimensions were 4ft. by 3ft. by 11ft. deep, which was found to afford convenient room for the suction pipe of the pump and a man to work. It was lowered into position with the open side to the wall; the top of the caisson being open and above water, afforded a free passage for men and materials. It will be seen from the above that when the caisson was thus in position the edges of the bottom and sides rested against the face of the wall. Round these edges a breadth of tarpaulin was nailed, extending outwards for a breadth of 4ft. all round and lying flat against the face of the wall. A $\frac{5}{8}$in. chain was sewn on all round the outer edge of the tarpaulin to make it lie "dead" against the wall and prevent it being curled up or washed away by the currents caused by the passing traffic in the canal.

For pumping out the caisson a pulsometer was used capable of discharging 9000 gallons per hour; the idea being that the current caused by pumping out the caisson would cause the tarpaulin to be drawn in tight against the wall, thus making a joint similar to that made by a limpit on the rocks of the seashore. On this being done, it was found that the current obtained by pumping was totally inadequate, as the tarpaulin resting normally on the higher portions of the face of the wall left considerable space between it and the face of the wall at the joints, thus affording so large an area for the ingress of water that the current caused by the pump was practically *nil*. On considering the matter it was seen that what was wanted was an instantaneous emptying of the caisson, when the rush of water would be so great as to carry the tarpaulin before it into the instertices between it—the tarpaulin—and the wall; but as this was impracticable, the same effect was produced in the opposite way—namely, by the instant filling of the caisson. To do this the open side of the caisson next the wall was boarded up watertight with the exception of the lower portion, where an opening was left measuring 4ft. by 3ft. To this opening a shutter was fitted, closing from the inside, and held in position by a strut. The caisson, being now a water-tight box, was lowered into position, and any leakage which had come in round the shutter having been pumped out, the strut supporting the shutter was knocked away, allowing it to fall inwards, leaving an opening 4ft. by 3ft. for the water to rush in. The effect of this was all that could be desired. The joint was instantaneously made, the caisson only filling up 7in. or 8in. The leakage was very slight, about 600 to 700 gallons per hour, which was easily kept down by the pump. To break the joint when it was required to move the caisson to another part of the wall, the shutter was replaced from the inside; the space then left between the outside of the caisson and the wall filled up by leakage when the tarpaulin floated off the face of the wall. The caisson was weighted sufficient to prevent it floating up when pumped out. A rock drill was used to bore the bolt holes, which were $2\frac{3}{4}$in. in diameter, and were drilled the full length—6ft. 6in.—in forty minutes.

Bow, June 9th. C. J. REYNOLDS.

THE TOWER BRIDGE.

SIR,—Since writing to you on the above subject I have been given to understand that the objections to the type of bridge as recommended by me are:—(1) The number of intermediate piers, which would cause an obstruction to the river traffic. But I would point out that collectively such piers would not occupy as much waterway as the two towers in Mr. Jones' scheme. Besides, there would be no engineering difficulty in making the two side spans, say, 260ft., and reducing the number of river piers to three. (2) The difficulty of keeping the shipping clear of the moving part of the bridge while it was swinging horizontally. With proper management this difficulty might be avoided. The up and down traffic would pass through separate openings, and the bridge would always swing away from an approaching vessel. A penalty for obstructing the opening of the bridge would cause captains of masted vessels not passing through to keep clear of the 110ft. quadrant on each side.

That Mr. Jones' scheme has been designed by an architect is clear, for no engineer would think of raising the centre piers of his viaduct 120ft. above the required height. If, as appears probable, 4000 or 5000 pedestrians would cross the bridge hourly, how inadequate will be the lifts to deal with this large traffic. Mr. Laybourne, in your last issue, makes a suggestion on this point, but I do not see how the lift could be less than 75ft. or 80ft., and as the saving of time would be very small, I believe the public would rather rise 100ft. and cross in the open air than descend 80ft. and cross in a subaqueous passage.

In your article you say the opening span is not likely to be used long, and Messrs. Ordish and Matheson say, "it is probable, and in our opinion almost certain, that in a few years' time the course of trade upon the river, and the inconveniences that must attend even the best kind of opening, will together cause the non-use of the opening part of the bridge." What, then, would Mr. Jones' bridge become, with its useless lifts and deserted high-level platform, but a monument of folly that would make English engineers the laughing-stock of the world. J. SOMES STORY.

Derby, June 13th.

AUTOMATIC FEED OF ROCK BORERS.

SIR,—The statements made by the inventor of the Barrow rock drill in your impression of the 12th inst. as to the non-success of the automatic feed in rock borers, which I believe is also supported by one or two other makers of rock borers with hand feed, ought not in justice to myself and others, who have brought out really successful automatic feed in our rock borers, and which were thoroughly and practically proved in every condition of the rock, to pass unchallenged.

Successful and unsuccessful inventions of automatic feed have been very different designs, and the automatic feed does not consist, as your correspondent says, in having a uniform and definite advance imparted to the tool, neither of altering mechanically the rate of feed to suit the varying hardness of the rock. A true automatic feed, pure and simple, as designed by Ferroux, myself, and others, consists in the unerring plan of allowing the tool to bore at definite distances, say from $\frac{1}{8}$in. to 1$\frac{1}{2}$in., before the working cylinder advances similar definite distances step by step, as by this means the hard veins, soft veins of the rock, cavities, or increasing bluntness of the tool do not affect the feed in the least. The tool has simply to bore at whatever rate of advance it is capable of, whether it be 1in. per minute in one part of the hole or 12in. in another part; the working cylinder simply follows it at the same rate automatically. Thus the tool may only have to make a few blows, or a great number for each following step of the cylinder.

Should the tool happen to be a little way from the rock in starting, or go into a cavity whilst working, this automatic feed will instantly bring it up to its work without any fear of accident, even though the pressure be turned full on; it will also withdraw the tool from the hole quickly, and I may also state that this system of automatically advancing the cylinder is simply done by the pressure, which forms an "air cushion," and this, with the absence of propelling gear, greatly increases the durability of the machine. I can give several instances of long and continuous successful working of various rock borers with automatic feed on the principle described above, but will content myself in mentioning those of Ferroux, used at the St. Gothard tunnel, which were selected as being the most successful after the trials of various kinds of rock borers, and were the only ones at work for many years till the completion of the tunnel. They were also used exclusively on one half of the Arlberg tunnel. I have had three of his rock borers at work for about eighteen months in one of the hardest known rock tunnels without a single failure of his automatic feed.

My object in writing this letter is not to disparage the hand-feed system, but to defend the successful automatic feed. I feel, however, constrained to say that in many positions of the borer with hand-feed in the tunnel, especially when near the top and working at an angle downwards, the operator often has to work the hand-feed in very awkward and constrained positions; thus instead of the machine being adapted for the man, the man has to be adapted to the machine, *i.e.*, by being "packed up" to it.

Bishop's Hill Cottage, Ipswich, GEORGE LOW.
June 17th.

TREVITHICK MEMORIAL.

SIR,—I was extremely sorry to find Dr. Hyde Clarke writing publicly in so acrimonious a strain upon the proposals issued from a meeting of the Executive Committee of the Trevithick Memorial, especially as he did not take the trouble to attend the meeting, to which he was summoned eight days previously by letter, and not by telegram, as he states.

If Dr. Hyde Clarke has proposals to make, I think it is not too much for the committee to expect that he will bring them forward in the usual course, and not confine himself to abusing the proposals of those members of the committee who take the trouble to attend the meetings. JOHN DAVIS, Lieut.-Colonel,

June 17th. Hon. Sec.

THE RATIO OF CONTRACTION OF AREA TO EXTENSION.

SIR,—On what authority Professor Unwin founds his startling assertion that I disagree with his mathematical deductions, I fail to conceive. If he will refer to my last letter he will find that I say his solution is correct. He has again brought forward some mathematical formulæ, but has left my question entirely unanswered, viz., how should the experiments he cited be read to agree with theory. I had hoped that in his answer he would have thrown some light on the relation which exists between the quality of a material and the form of the contraction near the fracture.

In some of my experiments with test pieces cut from one plate I have been able to alter the contraction from 44 to 65 per cent., while the elongation in 8in. ranged from 20 to 12 per cent. Thess results have for the present discouraged me from prosecuting the subject further, but I still have hope that the relation which exists between the quality of a material, its curve of stresses, and the shape of its contraction near the fracture will be explained, and only regret that Professor Unwin should have taken so much trouble to prove what must have been evident to everybody without entering into the more important question.

June 17th. C. E. STROMEYER.

ELECTRIC LIGHTING AT THE CRYSTAL PALACE.

SIR,—The Gulcher lamps at the Crystal Palace illuminated *fêtes* are suspended five or six feet down from the end of a short arm at the top of poles about 40ft. high, placed at various points of vantage in the grounds. From this mode of suspension, as the spectators move about, the upper end of a pole is sometimes between a spectator and the light, and close to the latter. The effect from the Terrace—which is at about the same height as the lamps, and at a distance of some 300 yards in some cases—is somewhat startling under these rather unusual conditions of suspension and view. As one walks along the Terrace there suddenly appears in front, and at right-angles to a lamp, a luminous cone, lost above in the realms of space; a little farther on the spectator finds himself within a similar but very dark cone of shadow. Standing at the edge, where the cones of light and shadow meet, the effect is very striking and singular, and affords besides a beautiful illustration in miniature of the shadow-cone of a sun eclipse with the penumbra. It may be added that a slight fog may have given additional potency on the night in question to an optical phenomenon, common as candle-light, but not so common under conditions of height and distance of observation, and a partially obscured and powerful ELECTRIC LIGHT.

June, 1885.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Matthew R. Miller, chief engineer, to the Vernon, additional; Henry M. G. Pellew, chief engineer, to the Pembroke, additional; James J. Walker, engineer, to the Hercules, additional; and Robert William Edwards, engineer, to the Victoria and Albert.

ON THE PURIFICATION OF WATER BY IRON ON A LARGE SCALE.

By W. ANDERSON, M. Inst. C.E.

IN January, 1883, in a paper on the Antwerp Waterworks read at the Institution of Civil Engineers, I described the application of Professor Bischof's method of filtration, through a mixture of spongy iron and gravel, to the purification of the waters of the river Nethe. The eighteen months' additional experience gained has shown that, so far as the purification of the water is concerned, Professor Bischof's process leaves little to be desired, but the working of the system has been costly, and the area of land required, as well as the quantity of iron necessary has, in the case of the Antwerp water at any rate, proved very much beyond the inventor's expectations. The increased demands of the town rendered it necessary to extend the arrangements for purifying the water, and it became my duty to advise the directors of the company on the best means of doing this.

The extension of Professor Bischof's method would have involved so great an outlay that after trying, unsuccessfully, many experiments on direct filtration through unmixed iron at high rates of flow, I determined to adopt a plan first suggested to me some years ago by our chairman, Sir Frederick Abel, of agitating the water to be purified with iron instead of attempting to filter it. The object, in either case, was to expose the water as much as possible to an extended surface of iron; consequently, any plan by which the iron could be made to keep itself clean by rubbing against itself continually would seem to be a more rational way of attaining this object than of trusting to a partial filtration through a more or less spongy material. The obstacle to trying Sir Frederick Abel's method at a much earlier date was the belief entertained by Professor Bischof that a contact of about forty-five minutes was necessary to ensure complete purification, and any such time would be fatal to mechanical means of performing the work. The late Professor Way and Mr. Ogston, it is true, had shown that with very finely divided iron the effect was much more rapid, but there was still a doubt about its permanence.

In the autumn of last year a revolving cylinder, 4ft. 6in. in diameter, and 5ft. 6in. long, was adapted to try Sir Frederick Abel's system. It was fitted with inlet and outlet pipes, and with shelves or ledges for scooping up the iron, raising it to the top of the cylinder, and then letting it fall through the water. At first I began to run water through at twelve gallons per minute, which gave a contact of about forty-five minutes, but I found that at this rate the water was very heavily charged with iron. I gradually increased the quantity to thirty gallons per minute, and then found that 1·20 grains of iron were dissolved per gallon, or about twelve times more than experience at Antwerp showed to be necessary. The flow was increased to sixty gallons, and even then 0·9 grain per gallon were dissolved. The experiment looked so hopeful that I fitted much larger pipes to the apparatus, and having made some other dispositions connected with maintaining a uniform distribution of iron in the cylinder, and preventing it being washed away by the comparatively rapid current that would be possible, I sent the "Revolver," as it came to be called, to Antwerp, where it was put to work at the end of last February and has continued to operate ever since. The head available for forcing the water through the "Revolver," is, at Antwerp, limited to 5ft., but by fitting very large pipes, I have managed to get 166 gallons per minute through; this gives a contact of about 3½ min., and is so amply sufficient that I feel sure that, even for the waters of the Nethe, much less time will be adequate. The charge of iron is about 500 lb., and the quantity taken up by the water, including impurities and very fine iron washed away, during a run of thirty-three days, was 0·176 grain per gallon. By making suitable arrangements, and choosing a favourable time with respect to the demands of the town, we were able to obtain samples of water that have been purified by the "Revolver" only; and after proper exposure to the air, followed by filtration through one of the large sand filters, the result obtained has been that the colour was very little different from distilled water, the free ammonia was reduced from 0·032 grain per gallon to 0·001, and the albumenoid ammonia from 0·013 grain to 0·0045. The "Revolver" turns at the rate of about $\frac{1}{4}$ revolution per minute, and requires scarcely appreciable power. The area occupied by apparatus for dealing with 2,000,000 gallons per day is 29ft. by 24ft., and it can be introduced into any existing system of filters, for by enlarging the in and outlet pipes to a suitable diameter, a head of some 12in. will suffice to pass the water through. It can easily be arranged so as to be used or not, as the state of the water to be purified may warrant, and the consumption of iron being only about 20 lb. per million gallons, is quite an insignificant expense. It will be found to remove all colour from water, whether caused by peat or clay, and will facilitate the action of sand filters by the peculiar curdling effect the iron has on the impurities. During the experiments made at Erith, it was noticed that considerable quantities of gas collected in the upper part of the "Revolver." On collecting this gas, it was found to extinguish a lighted taper instantly, and on analysis was found to contain only 8 per cent. of oxygen. It was observed from the first, that the animal and vegetable life which was so abundant and troublesome in the natural waters of the Nethe, lying over the spongy iron filters, had quite disappeared in the water, otherwise in exactly the same circumstances lying over the sand filters, and I always supposed that this was due chiefly to mechanical filtration through the spongy iron having separated all the germs, spores, and seeds which come to life above it. But during the recent hot weather it has been found that the water from the "Revolver," though it contains all the impurities of the natural water, has been modified by the action of iron to such an extent that neither animal nor vegetable life is apparent over the sand filters. Without presuming to draw very wide inferences from this fact with reference to the action of iron upon organisms connected with disease, it may, at least, be pointed out that the absence of visible life in water treated by iron on a large scale confirms, in a great measure, the experiments of Dr. Frankland, Dr. Voelcker, Mr. Hatton, Professor Bischof, and others. It is due to the last-named gentleman to state that to his persistent advocacy the introduction of iron as a purifier is mainly due. It must be borne in mind that the system does not depend on filtration only, but, first, on a process of exposure to iron, which decomposes the organic matter, and kills living organisms; and, secondly, on simple filtration, which merely separates the noxious matters which had been previously attacked by the iron. The waters of the Nethe are exceptionally bad, and heavily charged with impurities, so that the test both of Professor Bischof's and Sir Frederick Abel's systems has been very severe.

TENDERS.

GASWORKS FOR THE SCHOOLS AND WORKHOUSE AT MITCHAM.

FOR the construction of gasworks at the schools and workhouse at Mitcham for the Guardians of the Poor of the Holborn Union. H. Saxon Snell and Son, Southampton-buildings, London, W.C., architects.

	£
J. and F. May	5827
Willey and Co.	5379
J. T. B. Porter and Co.	5120
S. Cutler and Sons	4995
W. J. Fraser and Co.	4976
T. Piggott and Co.	4750
R. Dempster and Sons	4630
W. C. Holmes and Co.	4400
East Surrey Ironworks Company	4125
Ashmore, Benson, Pease, and Co.	4049
R. and J. Dempster	3100

LAUNCHES AND TRIAL TRIPS.

THE first vessel built at the new Elswick shipyard of Sir Wm. Armstrong, Mitchell, and Co., was launched on the 13th instant, in the presence of a large and distinguished company. She is one of a class of swift sea-going torpedo craft, which class is now receiving very numerous additions, both in this country and abroad. The Germans built one or two such vessels some years ago, but in recent years the French have taken the lead, and the English Admiralty has followed in the same track by ordering a number of the Scout class. The Austrian naval avthorities have from the very first paid the greatest attention to the development of their torpedo armaments, and the circumstance that the famous Whitehead locomotive factory at Fiume is in Austrian territory has, no doubt, helped to concentrate their attention upon this branch of construction. The Austrian torpedo flotilla includes a considerable number of torpedo boats, some of them of large size, and at the present time there are building in England two of the swiftest and largest torpedo boats yet laid down. Not content with this, the Austrian authorities have decided to add to their fleet a number of swift sea-going torpedo vessels, which should rival the corresponding vessels in foreign navies. Rather more than a year ago Baron de Haan, acting on behalf of his Government, invited tenders and designs for such vessels to be sent in by a number of the most eminent English shipbuilders, certain essential conditions of speed, equipment, and armament, as well as certain limitations of size being stated for the guidance of designers. As the result of this competition, the Admiralty authorities in Vienna decided to adopt the design prepared by Mr. W. H. White, formerly Chief Constructor at the Admiralty, and now at the Elswick Works; and about nine months ago the contract for the vessel was signed. The keel was laid on the 28th of October last, and the vessel has been very rapidly pushed forward, being in a very advanced condition at the time of her launch. The progress made is the more remarkable when it is remembered that the Elswick shipyard had only just been opened for work when this contract was arranged, and that its formation is still proceeding, although the heaviest portion of the work has been done. The Panther is of 1500 tons displacement, and her extreme dimensions are not very different from those of the Scout class in the English Navy. The engines are, however, very much more powerful, and consequently a considerably higher speed is anticipated than will be obtained by the Scouts. It is understood that any detailed description of the vessel is not to be published at present, but from what could be seen of her at the time of the launch it is obvious that in all her arrangements the most improved methods of construction have been adopted. The hull is throughout of steel, minutely subdivided into a large number of water-tight compartments. There are two separate boiler-rooms, and independent engines driving twin-screws. Over the boilers, &c., there is a steel protecting deck, which also forms a base for the upper coal bunkers, and the protection is increased by means of cellular double sides extending throughout the engine and boiler space, and made to serve as coal bunkers. A poop and high forecastle are built above the upper deck, and will add greatly to the seaworthiness of this very swift vessel, as well as afford comfortable quarters for officers and crew. The torpedo equipment is not yet in place, but provision is made for ejecting torpedoes right ahead through a tube fixed in the bow, and it is understood that there will be a number of other ejecting stations in different parts of the vessel. The engines and boilers are being made by Messrs. R. and W. Hawthorn, and the work of putting them on board will be commenced immediately at the Elswick shear legs. A sister-ship to the Panther is now rapidly approaching the condition for launching on the berth adjoining that from which the launch on Saturday took place, and on the other side is a still more powerfully protected cruiser, which is now in frame. It is a remarkable circumstance that this new yard of the Elswick Company should have been started with two vessels for the Austrian Navy, seeing that for more than a quarter of a century past all the war ships for that navy have been built at home; and the fact that the selection of the design for the Panther was made after the closest scrutiny by the able and independent authorities of the Admiralty in Vienna, shows their confidence in the naval architect with whom the design originated, and in the exceptional capabilities of the shipbuilding department of Sir W. Armstrong, Mitchell, and Co. Visitors to the launch on Saturday had evidence also that this confidence in the capabilities and resources of the firm is shared by the British Admiralty, for the first keel plates for H.M.S. Renown—one of the largest ironclads yet built—were lying on the blocks upon the special piled berth which has been prepared at great expense for the safe construction and launching of these enormously heavy vessels. There are to be two such berths in the Elswick shipyard, the piling of the second being now in hand. At the other end of the yard at the finishing jetty was to be seen the Chilian ironclad Blanco-Encalada, which is undergoing extensive repairs and alterations, including the complete refit of the hull, an entirely new armament, and rearrangement of the propelling apparatus.

Her Majesty's new war vessel, the Benbow, was successfully launched from the Thames Ironworks on Monday. A full account of the launch is given on another page.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, June 6th.

IMPORTS of pig iron for the month of April at this port were 3570 tons; spiegeleisen, 4080 tons; scrap steel, 159 tons; steel wire rods, 5305 tons; Swedish iron, 970 tons; tin-plate, 158,349 boxes; slab and ingot tin, 649 tons; nickel, 7266 lb. Stocks, May 1st, of pig iron were 3532 tons; spiegeleisen, 685 tons; old rails, 1110 tons; steel wire rods, 5549 tons; cotton ties, 1867 tons; Russian sheet iron, 600 tons; tin-plate, 50,759 boxes; nickel, 5882 lb. Exports of copper and matte for the month of April were 2,216,741 lb.; for May, 14,295,041 lb. Exports of sheet zinc for April, 17,023 lb.; May, 3260 lb. Wednesday's copper exports were 281,680 lb. Lake is dull at 11 dols. 40c. Lead is neglected; spelter flat, and tin-plate steady at 4 dols. 15c. Tin is quiet at 19 dols. 40c. The movement in iron and steel is characterised by sluggishness in not only tide water, but interior markets. Our latest private advices from the interior are to the effect that the suspension which took place June 1st will be maintained by the manufacturers until the full demand presents itself, or until the employés signify their willingness to accept the terms offered. Both sides are determined to fight the battle out, and while a great many are predicting concessions on one side or the other, the probabilities at present writing are that the contest will be prolonged, not only because of the dull demand, but because of the determination of employers to re-establish their authority in their mills.

A very active effort is being made to introduce the new steel making process, and some fourteen or fifteen licences have already been taken out, and by the close of this month the number will probably reach thirty or thirty-five. Three of these plants will be erected in Tennessee and Alabama, four of them in Eastern Pennsylvania, and the rest in the West. The demand for merchant steel is active, and the increase for steel rails in large blocks is indicative of a more active demand soon after July 1st.

The receipts of lumber from Southern and North-Western points continue heavy, and a very active distribution is going on of all kinds, including hard woods, and prices are everywhere a little firmer.

The coal trade is in a worse condition, the producers finding it almost impossible to dispose of stocks produced. This month's production of anthracite is 2,620,000 tons. No strikes exist. The organisation is being perfected in both the hard and soft coal regions, and advantage will be taken of any decided improvement in trade to advance prices.

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

(From our own Correspondent.)

THE approach of the end of the quarter causes some restriction to appear this week in the placing of specifications for deliveries of alike manufactured and raw iron. Consumers desire to have small stocks in their hands when they take stock at the end of this month. Forward buying, however, continues, and makers of finished iron who have a good merchant connection keep on steadily. Some of them have export orders upon their books that will carry them well into next quarter.

Sheets, small bars, and girder plates are in best sale. Tube strips are not much called for. Large rounds and squares for engineering purposes are in moderate call. Business in cable and chain iron is quiet, and makers of nail and wire rods are only partially employed.

As to prices, marked bars stand at £7 10s., with £8 2s. 6d. as the Earl of Dudley's quotation. The better qualities of unmarked bars are offered at £6 10s. down to £6 ; and other qualities, which are more inquired after, are £5 15s. down to £5 5s. Hoops are £6 down to £5 10s. at works, and tube strips £5 10s. down to £5 5s. Bedstead angles are an average of £6.

Merchant sheets, singles, are selling fairly well on the basis quotation of £6 7s. 6d. to £6 10s. Galvanising doubles are quoted £7, and trebles £7 15s. to £8. Galvanised corrugated sheet prices are not strong. The new list of Messrs. Morewood and Co., Lion Galvanising Works, Birmingham, shows a decline on a month ago of 10s. per ton. The new quotations for their Red Star brand are now:—18 and 20 b.g., £11 5s.; 24 b.g., £11 15s.; 26 g., £13 5s.; 28 g., £14 5s.; and 30 g., £16 5s. per ton. Their Lion brand becomes £11 15s. for 20 g.; £12 5s. for 24 g.; and £13 15s., £14 15s., and £16 15s. for the other gauges respectively. The reduction does not apply to close annealed flat sheets, which stand at for the Wheatsheaf brand, in cases, £13, £13 10s., £15 10s., and £16 10s. for 18 g., 24 g., 26 g., and 28 g. respectively. The Woodford Crown brand is named as £15, £15 10s., £17 10s., and £18 10s., according to gauge, and the Anchor brand at £17, £18, £20, and £21.

Steel makers in other centres continue to push business in this district with much success. Prominent among the consumers at date are the engineers and machinists, the edge tool and nut and bolt makers, the cycle manufacturers, and the ironmasters who produce sheets, small rounds and squares, tin-plates, hoops, and the like. The qualities on offer vary greatly, since the products represent the Siemens-Marten, the Bessemer, the Clapp and Griffiths, the basic, and other processes of manufacture. Prices also extend over a wide range. High-class Sheffield Bessemer sorts were quoted on 'Change in Birmingham this—Thursday—afternoon, and in Wolverhampton yesterday, at:—Sheets, up to 15 g., £10 10s.; 24 g., for stamping purposes, £14 to £15; plating bars, £6 10s.; billets, £5 to £5 5s.; and blooms, £5 to £5 10s.; Siemens-Marten qualities were £2 10s. per ton additional. Welsh steel billets can, however, be bought at from £4 10s. to £5 delivered, and blooms at £5 upwards. Simultaneously, Welsh plating bars are £5 15s. delivered. There is a good demand for plate ends and tires of mild steel for rolling down purposes. Plate ends delivered from Sheffield works are quoted £4 5s. per ton, and tires, £2 10s. up to £3 per ton. An enlarged trade is doing in this district also in spiegel, and best qualities are quoted £5 5s. per ton.

Tin-plate prices were somewhat stronger this afternoon, consequent upon the continued advance in the tin market. Messrs. T. W. and J. Walker, export merchants, express the opinion that, with the advanced prices of tin, tin-plates have touched the bottom figures.

The pig iron trade is not worse than a week ago, but no improvement can be announced. All-mine qualities are quoted 55s. for hot-blast makes; part-mines are 40s. and upwards; and cinder pigs, 32s. 6d. to 35s. Derbyshire pigs are 40s. to 41s., and Northamptons, 38s. and on. Sellers of Welsh scrap iron—sheet shearings—asked advanced prices to-day. The supply is decreasing, and the iron is worth more money. Sellers asked 50s. delivered, but buyers would seldom offer much beyond 45s.

Coal keeps in over-supply. Forge sorts vary in price from 4s. 9d. per ton at the pits to 6s. and on to 6s. 6d., according to the locality where mined. Furnace coal is 8s. to 9s. per ton.

The contracts which are just now offered upon the open market for steel rails and locomotives for Indian, colonial, and continental lines are matter for satisfaction. Some of the wrought ironwork needed by the Indian lines should come into this district.

A difference has arisen between the miners and employers at the Samson Colliery, Oldbury, concerning the contribution to be paid by the men to the Employers' Liability Assurance Corporation. The men are opposed to being connected with the Corporation, and they threaten a strike if the masters enforce the payment of contributions. A settlement is, however, likely to be arrived at.

A readjustment of wages is about to be effected at the Podmore Hall Colliery, near Newcastle-under-Lyme, of Messrs. Cooper and Craig. The change will not, however, amount to a reduction of 10 per cent. Mr. W. Y. Craig, M.P., who is the chief owner, states that during the last four years the colliery has not paid him a shilling, while, on the other hand, £30,000 has been expended in sinking the Minnie Pit, which will require a further outlay of £10,000 to fully develope. The opening up of this pit is to proceed, but it seems likely that the Hayeswood part of the colliery, where 200 men have given notice for an advance, will be closed altogether.

The Walsall Chamber of Commerce has this week approved the proposals embodied in the Machinery Rating Bill, introduced into the House of Commons by Mr. Norwood and other members. The council, however, unanimously passed a resolution against the Employers' Liability Act (1880) Amendment Bill, by which it is sought to prevent employers from contracting themselves out of the Act.

The North Staffordshire Chamber of Commerce makes known that complete success has attended its efforts in connection with the Manchester Ship Canal Bill. The promoters have accepted the arguments of the committee against the proposed increase in the charges for carriage between the Potteries and Liverpool, which, had they been allowed to become part of the Bill would have been almost prohibitive.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—Trade in this district still drags on in a slow, hand-to-mouth fashion, with nothing in the immediate future to indicate any early prospect of reviving activity. So far as prices are concerned, the basis on which orders could be placed, in most cases for delivery over the year, is so extremely low that it can only be a complete want of confidence in the future that holds back buyers from committing themselves beyond their immediate requirements. Here and there moderate inquiries are put forward, but the prices on which they are based are so much below what makers are at all likely to accept that they would seem to be simply sporting offers not really intended for actual business. The orders which buyers are compelled to give out to cover actual requirements, it is true, represent in the bulk a moderate weight of iron changing hands week by week, but these orders keep makers only indifferently employed, and they are under the further disadvantage of constantly seeking after new orders at the minimum figures.

There was not more than a moderate attendance in the Manchester iron market on Tuesday, and the business doing was very small. Prices were without material change from last week. Lancashire pig iron makers still hold to 39s. for forge and 39s. 6d. for foundry, less 2½, delivered equal to Manchester, and at about these figures they are getting small orders from their regular customers, who buy as they have to cover requirements; but in the open market they are still undersold by some of the district brands. For the leading brands of Lincolnshire iron prices quite equal to those of the local brands, and in some instances slightly above, are quoted, but there are sellers in the market at prices very much under, and in one or two cases district brands are to be got as low as 37s. 6d. and 38s., less 2½, delivered into the Manchester district, and on the basis of these figures one or two sales have been made. In Middlesbrough iron transactions to a moderate extent are reported, and for the best foundry brands 42s. 10d. net cash, delivered equal to Manchester, has been got. This, however, is an exceptional figure that is only obtainable in special cases, and there are ordinary north-country brands to be bought at about 1s. to 1s. 6d. per ton less. The firmer tone reported from Glasgow during the week had no apparent effect upon the market here, and Scotch iron has been offered at quite as low prices as ever.

In the manufactured iron trade there has, if anything, been rather more business stirring, and for the India, China, and South American markets orders are reported to be giving out somewhat more freely. There is, however, no sufficient improvement to make itself appreciably felt in the market. The forges are still, in most cases, only indifferently supplied with work coming in from hand-to-mouth, and prices continue on the low basis of £5 5s. to £5 7s. 6d. for good ordinary qualities of Lancashire and North Staffordshire bars, delivered into the Manchester district.

With the exception that tool makers are generally kept fairly well off for work, the reports as to the condition of the engineering trades show a decided slackening off in most branches. In heavy engineering work there is very little giving out, and some of the large shops are very slack. In the locomotive and railway carriage building trades, as I have previously reported, the large firms in this district are simply being kept busy for the present finishing work which is not being replaced by new orders. The leading boilermakers are moderately off for orders, and in some cases rather more business is reported to be stirring, but generally this branch of trade is also only dull.

In the branches of trade dependent upon engineering work, such as brass founders, and nut and bolt makers, business is reported as very quiet. For engineers' fittings the orders giving out are very small, requirements for the shipbuilding trade continue extremely limited, and nut and bolt makers are very short of orders, with prices all round cut down extremely low where any business is to be got.

The gasworks of the Manchester Corporation are already well-known for the modern appliances with which in the various departments they are equipped. In the direction of the mechanical charging of the gas retorts a further improvement is now being introduced at the Gaythorn Works, where Messrs. Hetherington and Co. are erecting, from the designs of Mr. Woodward, an arrangement for receiving the coal direct from the wagon-tips, breaking and discharging it into hoppers for supplying the Foulis stokers. The breaker, which can either receive the coal direct from the wagons, or can have the coal discharged into it by barrows from the stores, consists of three steel breaker rolls of different diameters, and running at different speeds. Each of these rolls carries three projecting teeth, and the coal is broken up between these rolls and a plate with teeth projecting downwards, which prevents the broken fragments from being thrown upwards, and the space between the plate and each roll diminishes until the fragments of coal are reduced to the requisite size. The broken coal then falls into iron buckets carried on an endless chain, which traverses the length of the retort house, and by a catch arrangement these buckets empty themselves into hoppers for supplying the Foulis stokers as required.

A steam cooker, especially adapted for coupling up to a steam pipe in works or on board steamships, or in large hotels where steam power has to be used, has been introduced by Messrs. W. H. Bailey and Co., of Salford. This apparatus, which is Bailey and Blamire's patent, consists of a wrought iron vessel encased in an outer shell, between which steam can be admitted at any pressure from about 40 lb. up to 100 lb. The food to be cooked is placed in the cast iron vessel, which is then hermetically sealed by screwing down a lid carried on a swivel above. The pressure of the steam regulates the time required for cooking, and apart from the advantage which such an arrangement for cooking presents where steam power exists to which it can be readily coupled up, it is claimed that by the exclusion of the air in this method of cooking, the heat and consequent evaporation which takes place cannot escape, and the result is that the meat and its juices do not lose weight, whilst it is uniformly cooked throughout. Several of these cookers have, I understand, been adopted with considerable success on the American line of steamers.

The half-yearly meeting of the Manchester Association of Employers and Foremen was held on Saturday, in the Manchester Technical School, Mr. W. H. Bailey, the president, in the chair. Four new honorary and three new ordinary members were elected, and it was resolved, if satisfactory arrangements could be secured for visits to works in the neighbourhood, that the usual summer excursion of the society should be made to Lancashire.

In the coal trade business has quieted down to a very dull demand for all descriptions of fuel, and collieries are either working short time or accumulating stocks. The termination of the Yorkshire strike has closed any extra outlet there may have been, and with the summer season now fairly set in, house-fire coals are very difficult to move. Common round coals continue in very poor demand for iron making and steam purposes, and slack for engine purposes is still plentiful in the market. A want of firmness characterises prices, and concessions upon quoted rates are made to effect sales. At the pit mouth best coals average 8s. to 8s. 6d.; seconds, 6s. 9d. to 7s. 3d.; common coals, 5s. to 5s. 6d.; burgy, 4s. 3d. to 4s. 9d.; good slack, 3s. 6d. to 3s. 9d., with common sorts to be got from 2s. 6d. per ton upwards.

Here and there collieries are occasionally kept busy with shipping orders, but generally this branch of trade is only moderate, and for good qualities of steam coal delivered at the high level, Liverpool, or the Garston Docks, not more than 7s. to 7s. 3d. per ton is being got, whilst there are sellers at as low as 6s. 9d. per ton.

Barrow.—The week's business in hematite qualities of pig iron has been of late very inconsiderable, and no life has been shown in any of the departments since the holidays, and in some cases partial activity observable at makers' work before the holidays has not been resumed. On continental account a very limited trade is being done, and from colonial and foreign countries the inquiry has been more than ordinarily restricted. Home buyers are ordering less iron than was the case a few weeks ago, owing to the less active state of the steel trade, and the consequent lessened consumption of Bessemer pig iron. Prices are undisturbed, the quotation which has ruled the market for several months—43s. 6d. for parcels of mixed qualities of Bessemer iron net at works—being maintained, with forge and foundry samples at 42s. to 42s. 6d. per ton net. Stocks are not smaller than they were, indeed, if anything, they have increased owing to the falling off which has been noticed in deliveries during the Whitsuntide holidays and since then. The rail mills are working short time, and the forward orders are scarce alike for rail metal, train sections, merchant qualities, plates, special steel and steel sleepers. The general steel trade in tires, axles, and forgings, is quiet, and likely to remain so if the present inquiry may be taken as any criterion. Engineers, ironfounders, and others employed in the general trades are fairly but not briskly employed, except in the case of marine engineers, who remain very busy. Shipbuilders are not in receipt of any new orders.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

COAL and iron continue at very low quotations, and even for the small business done at exceptionally weak prices there is keen competition. A few of the rates now freely offered will show to what values have fallen. Bessemer hematite pig iron, Nos. 1, 2, and 3, mixed, 52s. to 53s.; foundry and grey forge, No. 1, 52s. 6d.; Lincolnshire foundry, No. 3, 37s. 6d. to 39s.; Lincolnshire forge, 36s. 6d. to 37s. 6d.; Derbyshire foundry, No. 3, 37s. 6d. to 39s.; Derbyshire forge, 37s.; Bessemer steel billets, £4 7s. 6d. to £4 15s.; steel boiler plates, £7 15s. to £8 ; bar iron—merchant—£5 10s. to £5 15s.; sheets—iron—£7 10s. to £8 ; best boiler plates, £7 10s. to £7 15s.

In the cutlery and general hardware trades a better business is reported with the Cape and Australia, and orders are coming in more freely from India. In the home markets the advices from Ireland are most encouraging, and excellent prospects are offering in that country, unless some further disturbance should unsettle confidence again. The general elections, which cannot be postponed beyond November, will not be to the advantage of trade in the country districts.

Extensive preparations are being made by the Midland Railway Company to meet the extra traffic it expects at Cudworth Junction by the opening of the Hull and Barnsley Railway next month. Extra station accommodation is being provided, and Cudworth promises to be an important place in the combined railway system. Passing along part of the route the new line takes, I noticed this week that in spite of the depressed state of the coal trade, new pits were being opened at several places, so that the expectations of the promoters that the line would tap an extensive coal-field are likely to be realised. At one point I was informed that the house accommodation was already fully occupied, and that new dwellings were in course of completion for an expected increase of population by the arrival of colliers from a distance. At one place 700 new houses are to be erected. The Hull and Barnsley line will enable several leading Yorkshire coalowners to gain easier access to Hull, and this will have a most important effect on the export trade in fuel from that port.

A train of empty goods wagons was proceeding from the Barnsley junction of the Manchester, Sheffield, and Lincolnshire Railway last Friday afternoon, when, between Silkstone and Dodworth, the draw-bar of a private wagon dropped and dug into one of the sleepers. This caused the couplings to snap. The fore part of the train, with the engine, escaped without injury ; the eight following the private wagon were thrown off the metals and tore up the permanent way for some distance. Both lines were blocked, but a break-down gang from Mexborough promptly put the line to-rights in a couple of hours, and nobody was hurt.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

THERE was a fair attendance at the Cleveland iron market, held at Middlesbrough on Tuesday last, but the amount of business done was exceedingly small, and the tone was no better than on the previous Tuesday. Merchants' prices of No. 3, g.m.b., are now 32s. 3d. per ton for prompt, and 32s. 6d. for forward delivery. Consumers buy only sparingly and for immediate use, and none appear anxious to book forward even at the present low prices. Makers as a rule are maintaining their quotation for No. 3, g.m.b., at 33s. per ton; but it is only special brands which are able to command that figure. Forge iron is offered at the same price as No. 3. It is not so scarce as it recently was, because the mills and forges have been working less regularly than in the early spring.

The stock of Cleveland pig iron in Messrs. Connal's Middlesbrough store is now increasing. On Monday last the quantity held was 51,232 tons, being 500 tons more than a week previously.

Shipments of pig iron from the Tees are proceeding at a decidedly increased rate; but one-half of what is being sent away is going to Scotland, where it is being stocked, whilst Germany and other foreign parts are taking very little. Up to Monday last the total amount exported was 40,001 tons, as against 30,942 tons during the corresponding portion of May.

The outlook in the finished iron trade is gloomier than a month ago. The demand for shipbuilding iron has again fallen off, and though makers have lowered their prices 2s. 6d. to 5s. per ton, fresh orders are not to be had, and the mills are running less regularly. Prices remain the same as quoted last week.

The steel rail trade is also in an inanimate condition, and scarcely an order is obtainable. The Eston Rail Mills, belonging to Messrs. Bolckow, Vaughan, and Co., have been standing idle since Whitsuntide, and there is little probability that they will get to work again for some time. The price of rails is still £4 15s. per ton. The demand for steel plates is also slacker, and prices are somewhat weaker than they were.

The standing committee of the Board of Arbitration visited the Consett Steel and Ironworks on Monday last, and spent the whole day there. Their object was to settle the rates of wages to be paid to first heaters, second heaters, and rollers in the mill, which is now employed exclusively on steel plates. Hitherto the Board of Arbitration and its standing committee have only dealt with the wages of ironworkers proper, and have left steel makers and their operatives to settle their difficulties as best they could. The gradual increase, however, of steel making, and especially the changes in that direction which have been introduced by the Consett Iron Company, have recently made it increasingly evident that the Board must shortly undertake to settle all questions brought before it, whether connected with steel or iron. A resolution was lately passed declaring that wherever employers and operatives, in steel works or in the steel departments of ironworks associated with the Board, desired the assistance of the committee, it should be given. In obedience to this resolution the recent meeting took place. New rates were settled for each of the classes of operatives referred to, and it is understood that both they and the employers were well satisfied with the result.

The Consett Iron Company has already six 15-ton open hearth furnaces at work, making about 900 tons of ingots per week, and have two more in progress. The ingot, ingot moulds, and ladles, are manipulated entirely by two 7-ton steam cranes, mounted on the tops of shunting locomotives, and manufactured by Dubs and Co., of Glasgow. The ingot still hot is run into the mill, put on bogies, weighed, and first heated. Then it is wheeled to a powerful blooming mill, and in less than a quarter of an hour is bloomed on both edges, cut in two, cropped on the ends, weighed, and taken to the second heating furnace. From thence it is brought out at a full red heat and rolled into a plate in four or five minutes. First heating at present requires forty minutes, and second heating rather less. The blooming mill rolls about 80 tons per shift, and the plate mill 40 tons, the weight being taken on the finished product in either case. The steel melting plant is entirely new, but the rolling and heating plant has only been altered to suit the new conditions. During their visit the committee were handsomely entertained by the general manager, Mr. W. Jenkins.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THERE has been a fair business in the Scotch iron trade this week, but the values of warrants are low. At the beginning of the week they had declined to 40s. 9d. cash, there being since a little improvement. There are 91 furnaces in blast as compared with 92 in the preceding week, one having been put out at the Glengarnock Works. At this time last year 95 were blowing. The past week's shipments of pigs have been 9916 tons against 8780 in the preceding week and 11,151 in the corresponding week last year. The stock of pigs in Messrs. Connal and Co.'s stores shows an increase for the week of 970 tons.

Business was done in the warrrant market on Friday at 40s. 11d. cash. On Monday the market was very flat at 40s. 9d. cash. An improvement occurred on Tuesday, when transactions were noted at 40s. 10½d. to 41s. cash. On Wednesday business was done up

to 41s. 1d. To-day—Thursday—the market opened weaker, but afterwards improved, and closed at 41s. 2d. cash.

As the demand for makers' iron is slack prices are again somewhat easier this week. Free on board at Glasgow, Gartsherrie, No. 1, is quoted at 48s. 6d.; No. 3, 45s.; Coltness, 49s. 6d. and 48s. 3d.; Langloan, 49s. 6d. and 48s. 6d.; Summerlee, 48s. 6d. and 45s.; Calder, 52s. 6d. and 45s.; Carnbroe, 47s. and 44s. 6d.; Clyde, 46s. 3d. and 42s. 3d.; Monkland, 41s. 6d. and 39s. 6d.; Quarter, 41s. and 39s.; Govan, at Broomielaw, 41s. 6d. and 39s. 6d.; Shotts, at Leith, 49s. and 48s. 6d.; Carron, at Grangemouth, 52s. 6d. and 47s.; Kinneil, at Bo'ness, 43s. and 42s. 6d.; Glengarnock, at Ardrossan, 47s. and 41s. 6d.; Eglinton, 42s. 3d. and 38s. 6d.; Dalmellington, 44s. 6d. and 41s. 6d. The total shipments of Scotch iron to date are 212,711 tons, against 260,458 tons twelve months ago.

The past week's shipments of iron and steel manufacture from Glasgow included locomotives valued at £18,100 for Adelaide, £1570 machinery, chiefly for Australia, £4820 sewing machines, £2040 steel goods, and £47,740 iron manufactures.

In the coal trade merchants report a fairly good business, and the shipping department is busy. The week's shipment of coals embrace 23,411 tons at Glasgow, 2375 at Greenock, 2301 at Irvine, 7200 at Troon, 7906 at Ayr, and 11,191 at Grangemouth. There is no material change in quotations.

The lease of the Overtown Station Colliery in the Wishaw district of Lanarkshire, held by Messrs. Brand and Co., having expired, the pits have just been closed.

The miners of the Lanarkshire district are endeavouring to get the hours of work restricted to eight per day, beginning from Monday next, but it is doubtful whether a majority of the men will respond. It was asserted at a meeting of colliers held at Motherwell a few days ago, that they were earning only 2s. 9d. a day, and that when the usual charges for rent, &c., were deducted they had only 2s. 3d. clear money left, or about 14s. 6d. a week. If this is correct, it is not easy to see how the men can afford to work only eight hours daily.

Mr. Weir, the secretary of the Fife and Clackmannan miners, has again appealed to the employers for an advance of 10 per cent., but has received a letter from Mr. Connel, the masters' secretary, stating that the coalmasters regret they are unable to grant the request.

It is reported that Mr. Pearce, of Elder and Co., has resolved to lay down a 2000-ton vessel to keep his yard open, the intention being to fit her out as a China trader. Messrs. Blackwood and Gordon, Port-Glasgow, have contracted to build a steamer for passenger and goods traffic at Penang and Singapore. The last two stern-wheel steamers for the Nile are now all but finished by Messrs. Elder and Co., and they will make thirteen in all which they have supplied to the Admiralty within a short time. Eleven of these are now on the Nile.

A contract for 22,500 tons of water pipes for Cardiff are expected to be given to Glasgow makers, but the pig iron for their construction will likely come from the Cleveland district.

The principal bridge across the Clyde, at Jamaica-street, Glasgow, is to be widened at a cost of £25,000, in accordance with plans prepared by Messrs. Bell and Miller, C.E. A total increase of 30ft. will be given to the bridge, making it 88ft. between the parapets, or 4ft. wider than Westminster Bridge, the pavements being each 15ft., and the roadway 58ft. wide.

Messrs. J. B. A. M'Kinnel, of Dumfries Ironworks, have obtained a contract from the Glasgow and South-Western Railway to erect a new viaduct for the railway over the river Urr, near Dalbeattie. The contract price is £15,000, and the bridge will be of the iron girder type 426ft. in length.

WALES & ADJOINING COUNTIES.

(From our own Correspondent.)

IT has perplexed a number of outsiders to hear that the result of a meeting of the Sliding Scale Committee, held on Saturday at Cardiff, was to decree a reduction in the wages of colliers. Most people have regarded the coal trade of Wales as prosperous, and certainly, as regards quantity, there cannot be much complaint. But it is evident that prices are not exactly what they should be; and when secondary coals are classed with the others, prices are not up to the mark for a good average. The reduction of wages warranted by the average price will be 2½ per cent., and will date from 1st July. Enginemen and stokers will have to accept the same reduction, but theirs will not begin until August 1st.

I am told, in the inner financial circles of Cardiff, that with all our enormous output the number of thriving coalowners at Cardiff can be counted on the fingers of one hand. Many trades are dormant; shipping has not been a flourishing investment; iron ore has been dull, and has affected return cargoes; and Cardiff shipowners complain bitterly that while this country supports free trade, other nations do not, and they not only lose in failing to get return cargoes, but have to pay for ballast instead.

The coal clearances from Cardiff last week were amongst the highest on record. The total was 181,162 tons, being an excess of 37,000 tons over those of the previous week. From Newport the coal to foreign destinations amounted to 32,028 tons, and coastwise 24,507 tons. Swansea showed a little falling off, but some good cargoes left for Africa, France, West Indies, and South America.

The coal principally in demand is the best steam; house coal is a little quieter, though prices are firm. Small steam remains the same. Some amount of stocking is to be seen at collieries, showing that the demand is not quite so keen. As regards anthracite in the Swansea district, coalowners are fairly agreed that the demand is lessening and prices lowering.

Plymouth is turning out about 300 tons per diem from the new colliery. Care will have to be taken to prevent an inrush of the Taff river into this colliery. The re-opening has been carried out with a good deal of enterprise by Mr. Bailey, and I should be sorry to see any untoward result attend the re-winning.

The success of Cardiff and Swansea in patent fuel has roused Newport into rivalry, and works have just been completed, and a large quantity turned out. The coal of the district appears very suitable, and I think a hit has been scored, especially with reference to Swansea, which must suffer by the competition. Cardiff is exporting an average of 5000 tons weekly, Swansea about double.

An Admiralty order for best steam coal has been placed with the well-known Powell Duffryn Company.

Most branches of iron and steel continue lethargic. A few colonial rails and a less continental bar comprise the chief business.

If any one wished to see a contrast between the ironworks as they were under the iron kings, Crawshay and Guest, they should visit Cyfarthfa Works, bearing in mind their recollection of the old days of puddling, and mills full of active workmen. Cyfarthfa is the latest exhibition of the advance of science in ironmaking. Instead of a crowd of boisterous men at the rolls running out and sending back the rails, one man at the reversing rolls with a turn of the hand does all the business, and in the mills you only see a man here and there. Foreigners are continually arriving and visiting these works. This week a colonist from the Cape went over and was loud in praise of all the arrangements.

Things are rather quiet at Dowlais and at Rhymney.

De Bergue's old works, near Llandaff, are being altered to suit other industries, and the Garth are to follow.

Tin-plates are in better request, and prices show a tendency to look up. Gossip says that there are twenty works closed throughout the district, but this is certainly over-coloured. I should say that a dozen were closed, and the effect upon trade has been healthy. May business, looked at critically, was by no means bad. The United States took over 4000 tons more than in April, Canada 1000 tons more, France 40 tons more, and Australia 69 tons more. The increase in value amounted to close upon £37,000.

Ordinary cokes, 10, 20, by 14, are quoted at 13s. 6d.; wasters are low. In charcoals there is a slight advance. Some good cargoes left Swansea this week for the States.

The men out on strike in the Monmouthshire district are being supported by the men at work. In fact, there appears to be a stronger unionism amongst workmen than amongst masters, as shown in the failure lately by masters to agree about a reduction of make. Several meetings have been held, but to no good result. Terne plates are in good demand.

There is a prospect of pig iron being sent from Bilboa to Swansea, and a new trade worked up. The matter is one of importance, and dealers in foreign ores are regarding it with interest.

NEW ENGINEERING PROFESSORSHIP.—We call the attention of our readers to an advertisement appearing on our first page of a new professorship of engineering to be established in University College, Liverpool. Like Owen's College, Manchester, this College is now a part of the Victoria University, and the scientific Chairs already established are Mathematics, Physics, Chemistry, and Biology, besides Physiology and other more medical subjects. The addition of an endowed Chair of Engineering at this early stage is a healthy sign of growth and vigour, and a guaranteed endowment of £350 a year, in addition to a share of fees, should secure the appointment of a highly competent professor, especially if, as we understand, such consultation and arbitration work as is compatible with a due fulfilment of the duties of the Chair is recognised as permissible.

ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS.—The annual meeting to be held in London on Thursday, Friday, and Saturday, the 25th, 26th, and 27th June, 1885. The members will assemble at twelve o'clock noon on Thursday, the 25th June, in the Council Chamber of the Institution of Civil Engineers, Westminster. Thursday, June 25th.—10.30 a.m., council meeting, 6, Westminster-chambers; 12 noon, annual meeting of members in Council Chamber of the Institution of Civil Engineers, annual report, election of officers, alteration of bye-laws, general business, &c., president's address. Papers and discussion: "Street Lighting," by W. Santo Crimp, A.M. Inst. C.E, surveyor to the Local Board, Wimbledon; "Sanitary Gasmaking," by Professor J. A. Wanklyn. If time permits a discussion will be taken on "The Report of the Royal Commission on the Housing of the Working Classes," with address by E. B. Ellice-Clark, M. Inst. C.E., Hove. Friday, June 26th.—11 a.m., meeting in the Council Chamber of the Institution of Civil Engineers. Papers and discussion: "The Highgate-hill Steep Grade Tramway," T. De C. Meade, A.M. Inst. C.E., surveyor to the Local Board, Hornsey; "Dangerous Structures," S. Gamble, A.M. Inst. C.E., borough surveyor, Grantham. The Lord Mayor's reception—morning dress. 1 p.m., the members will leave the Institution and proceed by District Railway from Westminster Bridge Station to the Mansion House; 3 p.m., the members will then—by the kind permission of Lieut.-Colonel Haywood, M. Inst. C.E., City engineer—proceed to Farringdon Bridge to visit and inspect the Holborn Subways; 4 p.m., after which Mr. Horace Jones, F.R.I.B A., permits the members to inspect the London Central Markets. Permission is also given to visit the Deptford Market; members desiring this visit can take train from Cannon-street station to Deptford. Saturday, June 27th.—Visit to Blackfriars Bridge works; 9.45 a.m., members will meet at the entrance to these works in Upper Thames-street. Visit to Putney Bridge works; 11.15 a.m., leave by train from Blackfriars—District Railway—to Putney Bridge to visit the works now in progress there; leave Putney by District Railway for South Kensington to visit the Inventions Exhibition, the New Subway, &c. The number of members to be received on the 26th at the Mansion House is limited to seventy. In view of the applications possibly exceeding this number, it is to be understood that a ballot will be taken, or other means adopted as may be directed by the Council, to reduce the guests to the number stipulated.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

9th June, 1885.

6976. HANDLES of UMBRELLAS, &c., E. Newman and F. Glockler, London.
6977. WATER HEATERS, J. G. Carrick, Glasgow.
6978. WOODEN BELTING, F. T. K. Firmin, Liverpool.
6979. KEROSINE OIL LAMPS, W. H. and B. Jones, Wolverhampton.
6980. KEYS and LOCKS, W. H. and B. Jones, Wolverhampton.
6981. SEWAGE TRAP and GULLEY, R. Hill, London.
6982. MILLING WOOLLEN CLOTH, &c., J. Read, Leicester.
6983. TORPEDOES and SUBMARINE VESSELS, W. Welch, Southsea.
6984. HANDLE for BUTTON-HOOKS, &c., J. Jackson, Birmingham.
6985. DIGGING MACHINERY, J. Burfield, Hailsham.
6986. SLUBBING, &c., FRAMES, S. A. Lord, Rochdale.
6987. CURLING, &c., HAIR, G. Davis, Birmingham.
6988. MIXING and SIFTING POWDERS, &c., W. Laird, Dublin.
6989. FASTENINGS for PERMANENT WAY of RAILWAYS, T. Hampton, Manchester.
6990. GAS ENGINES, H. Campbell, Halifax.
6991. PREPARATION of TEA, J. W. Brown, Halifax.
6992. PURIFICATION of SEWAGE and SEWAGE WATER, M. Hilton, Holyrood.
6993. RAILROAD SIGNAL and CROSSING GATE, W. P. Thompson.—(*G. A. Reynolds, United States.*)
6994. SMELTING ORES, W. P. Thompson.—(*E. H. and A. H. Cowles, United States.*)
6995. EXPANDING the ENDS of CASKS, &c., W. K. Paterson, Liverpool.
6996. STEAMSHIPS, G. A. Newton, Liverpool.
6997. HORSESHOES, &c., J. Welsby, Liverpool.
6998. TURNING LATHES, J. Evans, Gaythorn.
6999. PLANE for CUTTING BREAD, &c., L. A. Groth.—(*W. Spilger, Germany.*)
7000. RAISING and LOWERING RAILWAY CARRIAGE, &c., WINDOWS, H. Defries, London.
7001. VALVES for AIR PUMPS, F. O. Bynoe, Ealing.
7002. DRIVING INSTRUMENTS EMPLOYED for CUTTING HUMAN HAIR, W. Clark, London.
7003. SODAGENE, H. A. Costerton, Brighton.
7004. CLEANSING WOOL, &c., J. Hanford, Halifax.
7005. RAILWAY CHAIRS, B. W. Jackson and R. S. Ashton, Halifax.
7006. FISHING-ROD HOLDER, F. Fagan and S. Skerritt, Sheffield.
7007. WATCH-MAKERS' and JEWELLERS' PLIERS, R. Oehler, London.
7008. COLLECTION and RETENTION of TIN, &c., ORES, E. H. and W. R. Oswald, London.
7009. FURNACES for SMELTING METALS, &c., T. May, London.
7010. SIGNALLING, &c., BETWEEN RAILWAY TRAINS, T. J. Handford.—(*T. A. Edison and E. T. Gilliland, United States.*)
7011. SELF-INKING STAMP PADS, B. G. Volger, Brooklyn, U.S.
7012. STEAM GENERATORS, I. Engelson, Jersey.
7013. RAILWAY SWITCHES, E. S. Cartman.—(*E. A. Trapp, United States.*)
7014. STEEL INGOTS, H. J. Allison.—(*Compressed Steel Company, United States.*)
7015. FLYING TARGETS, L. H. Macomber, London.
7016. TREATING FISH-ROE, E. E. Waters, London.
7017. INK FILTER, J. M. Dennison, London.
7018. MOVABLE SHANK for SLEEVE LINKS, &c., T. Hart, London.
7019. METAL MOULDS for CASTING STEEL WHEELS, J. H. Johnson.—(*W. Sellers, United States.*)
7020. SCREWED BOLTS, STUDS, &c., J. Harrower, Glasgow.
7021. AUTOMATIC ELECTRIC LIGHTING APPARATUS, C. S. Snell, London.
7022. RANGE FINDER, E. Wright, Southend-on-Sea.
7023. LAMPS, A. J. Boult.—(*M. Matthews, Canada.*)
7024. HYDRAULIC VALVES, P. A. Newton.—(*C. R. Crane, United States.*)
7025. REARING POULTRY, J. J. Scott, Deptford.
7026. PERMANENT WAY of RAILWAYS, J. H. Betteley, London.
7027. MOTIVE POWER for VELOCIPEDES, J. Whittingham, London.
7028. IRREGULAR SHAPED METAL ARTICLES, G. F. Simonds, London.
7029. COOKING by GAS, G. Manning, London.
7030. ROWLOCKS, G. Hughes, London.
7031. CLEANING SHIPS' BOTTOMS, A. H. Reed.—(*N. A. Gustafson, U.S.*)
7032. CLEANING GRAIN, C. A. Day.—(*W. A. Cockrell, U.S.*)
7033. CORDS for PICTURES, &c., G. Hookham and W. H. Tonks, London.
7034. IRON and STEEL TUBES, &c., E. Dixon, London.
7035. MAKING ICE, Maschinenfabrik Germania and P. Elfertz, London.
7036. STEAM ENGINES, H. Otway and F. S. Snowdon, London.
7037. CURLING, &c., HAIR, W. Bown and G. Capewell, London.
7038. TRIMMING WICKS, W. Bown and G. Capewell, London.
7039. SOLITAIRE and other STUDS, W. H. Hall, London.
7040. ADJUSTABLE STAND for HOSPITALS, W. Shrubsole, London.
7041. WHEELS A. Piget, London.—21*st March* 1885.
7042. STEEL, H. H. Lake.—(*H. E. Cahen, France.*)
7043. RAILWAY GOODS TRUCKS, H. H. Lake.—(*W. A. Tarver and A. Bryan, Australia.*)
7044. PRINTING MACHINES, H. H. Lake.—(*C. B. Cottrell, U.S.*)
7045. STEAM ENGINES, H. H. Lake.—(*R. Cox, U.S.*)
7046. SPRINGS for CARRIAGES, H. H. Lake.—(*W. J. Bunker, U.S.*)
7047. BILLIARD TABLES, F. R. Wright, London.

10th June, 1885.

7048. LINE-THROWING GUNS, D. R. Dawson, Glasgow.
7049. HEELS and SOLES of BOOTS, &c., J. Brown, Manchester.
7050. SAFETY BICYCLES, S. Leek, Bloxwich.
7051. SAFETY JOINT for BRACELETS, &c., J. S. Whitten and H. G. Plant, Birmingham.
7052. AUTOMATIC FLUSHINGS for LAVATORIES, &c., M. Ingram, Manchester.
7053. DISCHARGE and WASTE ARRANGEMENTS for BATHS, &c., M. Ingram, Manchester.
7054. CLOSING BOTTLES, JARS, &c., M. Stephenson, Manchester.
7055. WARMING and VENTILATING ROOMS, &c., H. T. Johnson, Urmston.
7056. AIR-TIGHT VESSELS for PRESERVING FOOD, H. T. Johnson, Urmston.
7057. OPENING, &c., WINDOW SASHES, W. McGill, London.
7058. RAISING STAMP HEADS for SHAPING METALS, A. C. Hands and F. Parkes, Birmingham.
7059. CHECKING the AMOUNTS PAID for ADMISSION, W. A. M. Brown and J. M. Porter, Leeds.
7060. PIPE TUBE and STUD WEDGE GRIP, J. Lynn and W. Timmis, Darlington.
7061. GRIPPING CORDS, ROPES, CABLES, &c, J. Carver, Walsall.
7062. SPINNING COTTON, &c., T. S. Whitworth, Manchester.—20*th April*, 1885.
7063. HERMETICALLY CLOSING and STOPPERING BOTTLES, R. Potter, Barnsley.
7064. CAN-TRUCK for MILK, OILS, &c., E. Roden, Wolverhampton.
7065. REGULATING the SUPPLY of WATER, &c., T. G. Messenger, Loughborough.
7066. PANEL-PLANING and THICKNESSING MACHINES, E. and G. H. Warburton, Bury.
7067. AXLES for COACHES, &c., C. H. Marshall, F. Sanders, and N. Smythe, Birmingham.
7068. CARDING ENGINES, W. Dobson, Manchester.
7069. MACHINE for CUTTING FABRICS, A. Sutcliffe, Rochdale.
7070. FOLDING CHAIRS, W. Morrison and J. W. Benn, London.
7071. IRIDISING METAL OBJECTS, A. Ephraim, London.
7072. FASTENING for GLOVES, &c., R. Wallwork, London.
7073. INCREASING the SPEED of BOATS, T. Crowford, London.
7074. ELECTRIC ARC LAMPS, F. L. Muirhead, London.
7075. COVERS for JUGS, &c., E. A. Brownfield, London.
7076. TRANSMITTING ROTARY MOTION, E. Wilson, London.
7077. A BOOK in a BOX which is also to contain POST-CARDS for keeping a RECORD of WRITTEN MATTER on the said Post-card, F. Davies, Edmonton.
7078. METALLIC BEDSTEADS, J. R. C. Taunton and H. Ferrer, London.
7079. OBTAINING CARBOLIC ACID, &c, from TAR OILS, J. Hardman, Manchester.
7080. LOCKING NUTS upon their SCREW BOLTS, A. F. L. Bernard, London.
7081. CUTTING and PRICKING CIGAR ENDS, E. M. Moore, London.
7082. ADHESIVE ANTI-DRY-ROT COMPOSITION, J. F. Ebner, London.
7083. DOORS or COVERS for COAL BOXES, &c., C. Sims, London.
7084. INSTANTANEOUS SHUTTERS for PHOTOGRAPHIC CAMERAS, H. J. Haddan.—(*C. Lütken, Denmark.*)
7085. FOUNTAIN PENS, H. J. Haddan.—(*L. Fried and B. Iscovits, Austria.*)
7086. JOINERS' CLAMPS and SCREW PRESSES, H. J. Haddan.—(*P. Chaussivert, France.*)
7087. BRIDLE BITS and SNAFFLES, C. Hübner, London.
7088. SEAMLESS RUBBER TUBE, &c., M. R. Hutchinson, London
7089. SLATES, F. Müller, London.
7090. HEATING WATER, H. Otway and F. S. Snowden, London.
7091. PIPE COUPLINGS, A. J. Boult.—(*A. Dorgans, France.*)
7092. LUBRICATORS, &c., A. J. Boult.—(*P. Macabies, France.*)
7093. TREATING SULPHATE of IRON SOLUTION, M. I. E. Morris, London.
7094. PREPARING COTTON, &c., W. R. Lake.—(*A. Clarke and H. C. Perham, U.S.*)
7095. GAS STOVES, W. R. Lake.—(*J. W. Baker, U.S.*)
7096. PLAYING PIANOS, &c., C. D. Abel.—(*J. Carpentier, France.*)
7097. LAWN TENNIS POLES, W. Brenton, London.
7098. GRAPE SUGAR, &c., O. Korschelt.—(*H. Soxhlet, Bavaria.*)
7099. CYCLOMETERS, T. W. Short and W. J. Mason, London.

11th June, 1885.

7100. DECORATIONS upon GLASS, &c., W. R. Readwin, London.
7101. WRENCHES, J. Drewitt, London.
7102. JACQUARD for WEAVING FABRICS, M. Priestley, H. and R. T. Lord, and I. Thomis, Bradford.
7103. WATER WASTE PREVENTER CISTERN for WATER-CLOSETS, E. G. Wright and T. C. Summers, Portsmouth.
7104. GAS MOTOR ENGINES, G. Warsop and H. W. Hill, Nottingham.
7105. REGULATING LUBRICATOR, H. Bromley, Longton.
7106. MAKING SEWAGE PIPES, A. Patrick, Glasgow.
7107. TESTING the CONDITION of EGGS, C. V. Boys, London.
7108. STOPPING and RESTARTING TRAM-CARS, J. Shaw, T. Harrison, W. Shaw, and G. Douglas, Bradford.
7109. LETTING-DOWN MOTIONS for LOOMS, E. Barlow, Manchester.
7110. LOCKS for LETTER-BOXES, F. Squirl and J. Gunn, Tiverton.
7111. PIGMENTS, G. L. Wigg, M. Steele, and W. J. Wigg, Liverpool.
7112. WASHING and PEELING POTATOES, A. Barrett, Sutton Mill.
7113. RAILWAY RUNNING SWITCH-BOX, E. and J. H. Walker, Rotherham.
7114. GRAMME ARMATURES, G. E. Dorman, Stafford.
7115. BLASTING MINES, W. Beatson, Rotherham.
7116. ENGINE PISTONS, A. Thornton and S. Roberts, Halifax.
7117. WEIGHTING STOPPERS, R. Walton, London.
7118. FLOWER HOLDER, G. Davis, Birmingham.
7119. ROTARY PUMPS, E. Schergen, Liverpool.
7120. MILL PLANT for MAKING WIRE RODS, E. S. Lenox, Liverpool.
7121. PAINTS, &c., D. Melville and J. F. Whitney London.
7122. REMOVING MUD from CLOTHES, A. O. Kelso, Liverpool.
7123. TENTS, W. Pitt and W. Morgan, Stratford.
7124. SECURING CHIMNEYS, E. Marland, Oldham.
7125. COOKING RANGES, R. Nisbet, Glasgow.
7126. CHEMICAL PRECIPITATION, J. G. Lorrain, London.
7127. ORDNANCE, J. A. Longridge, London.
7128. ELECTRIC CABLES, J. W. Butler, London.
7129. WATERPROOF CLOTHING, A. Chism, Belfast.
7130. EXTRACTING PRECIOUS METALS from ORES, C. H. McEuen, London.
7131. HEATING WATER COILS or RADIATORS, W. G. Cannon, London.
7132. REGULATING the TEMPERATURE of AIR or GASES, A. C. Hill, Middlesbrough-on-Tees.
7133. PISTON for RECIPROCATING ENGINES, G. C. Offen, London.
7134. AXLE-TREES, A. Bruckner, London.
7135. BICHROMATE of POTASH, P. Römer, London.
7136. HYDRATE or CARBONATE of STRONTIUM, &c., E. F. Trachsel, London.
7137. ADJUSTABLE CHAIR, A. McDonald, London.
7138. SHUTTLE GUARD for LOOMS, A. Wilkinson and J. Shawcross, London.
7139. LADY'S UNIVERSAL BRUSH, V. Luksch, London.
7140. PRODUCING HONEYCOMB QUILTING, E. S. Hammett, London.
7141. PARING, CUTTING, &c., the BRIMS of HATS, W. H. Dorman, London.
7142. INDEX BOOKS, J. B. Burt, Middlesex.
7143. MORSE INKER APPARATUS, C. D. Abel.—(*Siemens and Halske, Germany.*)
7144. BRANDING or PRINTING in WOOD, &c., J. Collis, London.
7145. FASTENING of EAR-RINGS, J. C. Pocher, London.
7146. GREASE RECEPTACLE for CARRIAGE AXLES, H. J. Haddan.—(*E. Jacquelin, France.*)
7147. REGISTERING THERMOMETERS, &c., W. Müller.—(*C. Derckmann, Germany.*)
7148. METALLIC COMPOUND for FLOORING, &c., C. A. Wilkes and W. Millar, London.
7149. PERMANENT ROADWAY for TRAMWAYS, &c., C. A. Wilkes, London.
7150. COUPLINGS for PIPES, &c., N. Thompson, London.
7151. ANCHORS, H. G. Crow, London.
7152. MARKING PATTERNS on TEXTILE FABRICS, H. Willey and J. W. Robbs, London.
7153. THERMOSTATIC HEAT RECORDER, &c., J. Gilmore and W. R. Clark, London.
7154. WATCHES and CLOCKS, G. Thommen, London.
7155. CARTRIDGES, T. Nordenfelt, London.

7156. TREATING PAPER PULP, H. H. Lake.—(*J. Jordan, United States.*)

12th June, 1885.

7157. SLIDING SASH FRAME for CARRIAGE DOORS, H. W. Williams, Clifton.
7158. ATTACHING FLYERS to SPINDLES, F. W. Lawson and T. K. Hattersley, Leeds.
7159. SPINNING and TWISTING FRAMES, F. W. Lawson, Leeds.
7160. ORGAN PIPES, J. J. Walker, London.
7161. PRECIPITATING COPPER from SOLUTIONS CONTAINING SULPHATE of COPPER, E. Hunt.—(*M. T. Brown, United States.*)
7162. SPRAY LAMPS, J. B. Hannay, Glasgow.
7163. COUPLING APPARATUS, F. J. Hewitt, Liverpool.
7164. LUBRICATORS, W. P. Thompson.—(*R. Wrigley, East India.*)
7165. TRICYCLES, C. Stout, and F. S. and J. A. Bayley, Liverpool.
7166. TOBACCO-PIPES, S. Amphlet, Birmingham.
7167. PREVENTING STEAM BOILER EXPLOSIONS, T. Beddous and J. Brown, Birmingham.
7168. CASTORS, S. Timings, Birmingham.
7169. GUM BOTTLE, B. L. F. Potts, London.
7170. SWEEPING and REMOVING REFUSE from STREETS, &c., H. Whiley, Manchester.
7171. ADVERTISING, S. J. Ewing, Birmingham.
7172. STEAM ENGINE, J. Womersley, Littletown-in-Liversedge.
7173. SPINDLE TUBE for CAP SPINNING, &c., W. C. and J. Whitehead, Leicester.
7174. REGULATING STOPPERS for BOTTLES, P. Jackson, London.
7175. INDICATING, &c., the SPEED and DISTANCE RUN by SHIPS or VESSELS, J. Young and J. Richardson, London.
7176. CURING RHEUMATISM, S. Nash, Winnipeg.
7177. WATER HEATERS, F. A. Whelan, London.
178. BREAKING FIBROUS PLANTS, M. Raabe and F. H. Zimmermann, London.
7179. IRON and STEEL, J. H. Johnson.—(*La Société Anonyme Le Ferro-Nickel, France.*)
7180. ADJUSTABLE CHAIRS and SOFAS, &c., C. Baker and G. H. Clack, London.
7181. RACKS for HOLDING BRUSHES, &c., H. A. Cochran, Glasgow.
7182. REMOVING DUST from CARPETS, &c., W. Milward and B. Richards, London.
7183. HANSOMS and other VEHICLES, H. Brockelbank, Streatham.
7184. ASBESTOS PACKED COCKS, J. Dewrance and G. H. Wall, London.
7185. CASK STAND, A. S. Bishop and F. Down, London.
7186. TREATING MATTERS SEPARATED from the WATER in which WOOL, &c., have been BOILED, W. Jones and C. Kilpatrick, Manchester.
7187. PURIFYING, &c., YARNS or THREADS, J. C. Mewburn.—(*Georges Lombard et Compagnie, France.*)
7188. ATTACHING METALLIC BUTTONS to TROUSERS, &c., W. D. Player, London.
7189. CEMENT, W. Joy, London.
7190. GLASS PAPERING MACHINE, W. Cutlan, London.
7191. BOX FLUES, J. A. and A. A. Clarke, London.
7192. VENTILATING APPARATUS, C. Groombridge, London.
7193. PROPULSION, &c., of BALLOONS, C. Groombridge, London.
7194. ELECTRO-HYDRAULIC VACUUM APPARATUS, B. J. Mills.—(*C. Diener and C. A. Mayrhofer, Austria.*)
7195. ALKALINE EARTHS, J. Mactear, Glasgow.
7196. DEEP WATER DIVING APPARATUS, G. H. Leane, London.
7197. BRUSHES, R. B. Breidenbach, London.
7198. EXTINGUISHING LAMPS, H. Lowe, London.
7199. IRON WHEELS, E. Pritchard, London.
7200. PLOUGHS, J. Oliver.—(*C. Anderson, U.S.*)
7201. FIRE-BARS, D. J. Morgan and J. H. Plews, London.

13th June, 1885.

7202. KNITTING MACHINES, H. Kiddier, London.
7203. PULLEY FRAMES, &c., C. Twigg, Aston.
7204. COOKING RANGES, G., G., and J. Kinnaird, Langside.
7205. FIXING the ENDS of a SCARF to a SHIRT FRONT, J. Rogerson, London.
7206. LAMP and STOVE WICKS, &c., C. and W. Crisp, Halstead.
7207. LOCKS and LATCHES, W. W. Smith, Maidstone.
7208. ATTACHING DOOR KNOBS to their SPINDLES, A. Hogg, Birmingham.
7209. ATTACHING DOOR KNOBS to their SPINDLES, C. T. Powell, Birmingham.
7210. STRINGING UP and TUNING of PIANOS, &c.. T. Doddrell, Slough.
7211. JACQUARD of WEAVING LOOMS, J. Crabtree and J. Brearley, Halifax.
7212. REGULATING the BLAST of LOCOMOTIVES, S. Morley, Liverpool.
7213. EXPANDING the ENDS of CASKS, W. K. Paterson, Liverpool.
7214. AUTOMATIC GEAR for OPENING and CLOSING EXCAVATORS, W. F. Batho and S. M. Cockburn, London.
7215. ADVERTISEMENTS on REVOLVING SHUTTERS, M. Diosy.—(*L. Diosy, Austria.*)
7216. BICYCLES, B. Esmarch, Balsall Heath.
7217. PREPARING and SPINNING MACHINERY, &c., B. A. Dobson, Bolton.
7218. HOLDER for HEATING FLAT-IRONS, C. Gamwell, Liverpool.
7219. CLOTH for CURTAINS, R. C. Willey and W. A. Anderton, London.
7220. CONDENSER STRIPPER RINGS, J. and R. Sellers, London.
7221. VELVETEENS, W. E. B. Priestley and W. Bottomley, London.
7222. CARBON for ELECTRIC LAMPS, J. Y. Johnstone.—(*La Société A. Chertemps et Cie., France.*)
7223. PRESERVING LEATHER, P. M. Justice.—(*A. Sandron, Belgium.*)
7224. CLEANING TENNIS BALLS, C. F. Parsons, London.
7225. COOKING FOOD, W. Lawrence, London.
7226. METALLIC SCREW CAPSULE STOPPERS. A. J. T. Wild, London.
7227. METALLIC CROSS SLEEPERS for RAILWAYS, A. F. L. Bernard, London.
7228. OPENERS and SCUTCHERS, R. Schaellibaum, London.
7229. BUFFERS for RAILWAY VEHICLES, R. H. Hepburn, London.
7230. DISINFECTING PREPARATION, E. W. Bickerton.—(*A. E. W. Howe and W. R. Bickerton, Tasmania.*)
7231. BLOWING MOLTEN COPPER, R. G. Brook, Liverpool.
7232. TELEPHONIC TRANSMITTERS, &c., R. H. Ridout, London.
7233. RACKET HOLDER and PRESS, R. W. Ashby, London.
7234. SEWING MACHINE GUIDES, &c., T. H. Williams, London.
7235. STYLOGRAPHIC or FOUNTAIN PENS, H. Holdsworth, London.
7236. OVERHEAD LAMPS, A. M. Silber, London.
7237. CONTINUOUSLY ACTING CENTRIFUGAL APPARATUS, J. Imray.—(*La Compagnie de Fives-Lille, France.*)
7238. BOILER and other FURNACES, &c., W. Westlake, London.
7239. SECURING RAIN PIPES, H. W. Allan, Glasgow.
7240. GAS GOVERNORS, J. Stott, London.
7241. FILLING and STOPPERING BOTTLES, R. L. Howard, London.
7242. TRANSMITTING HEAT, G. G. M. Hardingham.—(*J. Grouvelle, France.*)
7243. LIQUID METERS, O. Brown, London.
7244. TOOL for SHAPING the NECK PORTION of BOTTLES, &c., W. C. Cartmel, London.
7245. OPERATING EXPLOSIVE PROJECTILES, J. S. Williams, Riverton, New Jersey.
7246. OPERATING, &c., VESSELS ELECTRICALLY, J. S. Williams, Riverton, New Jersey.
7247. CONVERTING MECHANICAL into ELECTRIC FORCE, J. S. Williams, Riverton, New Jersey.

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7248. SUCKING DRAGS, A. Casse, Liverpool.
7249. PORTABLE MATTRESS, C. Till, Leicester.
7250. POTTERY KILN, J. Broadhurst, Stoke-on-Trent.
7251. BASKET, WICKER, &c., WORK, G. P. Taylor, Birmingham.
7252. DOVETAILING MACHINES, J. Anderson, Newcastle-on-Tyne.
7253. STANDS for HOLDING GLASSES, &c., J. Morton, Birmingham.
7254. FASTENINGS for WINDOWS, A. T. Littleford, Birmingham.
7255. STEERING VELOCIPEDES, &c., J. Higham, Manchester.
7256. HAND FUMIGATORS, W. D. Luff, Farnham.
7257. SUSTAINING RUPTURE, A. Hodges, Ryde.
7258. FEEDING-BOTTLE REGULATORS, E. F. Stockwell, Moseley.
7259. DOBBIES or SHEDDING MOTIONS, R. Ecroyd, London.
7260. HORSES' WINTER SHOES, W. J. Nash, London.
7261. STOPPERS for BOTTLES, J. Rebbla, Halifax.
7262. METALLIC DRAWER-HANDLES, S. H. Keeling and F. C. Smith, London.
7263. RAISING, &c., WINDOWS, J. E. Hopkinson and O. Gibson, London.
7264. CLOSET, H. Le Bas, Sevenoaks.
7265. FASTENING BUTTON BOOTS, &c., E. Johnson, Northampton.
7266. LACE CURTAINS and BLINDS, J. F. Forth, London.
7267. BINDING STRAW, T. P. Mayos, London.
7268. STRETCHING HIDES, G. Cumberpatch.—(*A. Jesson, France.*)
7269. BOOTS, &c., H. J. Haddan.—(*E. Kaiser, Saxony.*)
7270. COMPASS and COURSE CORRECTOR, R. H. T. Plumb, London.
7271. STRAP FORKS or BELT GUIDES, G. Greenwood, London.
7272. MOUNTING CHAIRS, &c., J. C. Mewburn.—(*A. P. E. Bonnard, France.*)
7273. UMBRELLAS, C. H. Butlin, London.
7274. TRANSMISSION of SOUND, &c., C. J. Wollaston, London.
7275. WINDING BOBBINS for LOOM SHUTTLES, W. Atkinson, London.
7276. HOLDING TOGETHER PAMPHLETS, &c., W. A. Shaw, London.
7277. LAMPS or STOVES, C. Barton, A. Rotherham, and the Barton Burner Company, London.
7278. DISINFECTING RAGS, H. M. Martyn, London.
7279. GALVANIC BATTERIES, A. M. Clark.—(*C. R. Goodwin, France.*)
7280. PERFORATING DEVICES, E. D. Peacock, London.
7281. SECURING RAIL KEYS in their CHAIRS, G. A. Goodwin and W. F. How, London.
7282. PILLOWS or CUSHIONS, W. R. Lake.—(*H. S. Sternberger, U.S.*)
7283. POWER LOOMS, S. C. Lister and J. Reixach, Bradford.
7284. FINISHING PILE FABRICS, S. C. Lister and J. Reixach, Bradford.
7285. BURNING ORES and MINERALS, R. and C. Oxland, London.
7286. HOLDER for HOLDING CHALK for CHALKING BILLIARD CUES, E. Tonks, London.

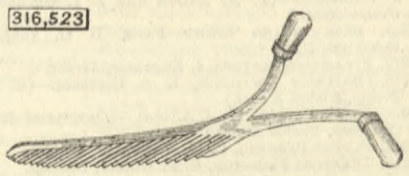
SELECTED AMERICAN PATENTS.

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

316,523. HAY KNIFE, *Wallace H. Carter, Hallowell, Me.—Filed November 29th*, 1884.

Claim.—In a hay knife, a blade having a diagonal grooved face and a back portion of less thickness than

316,523

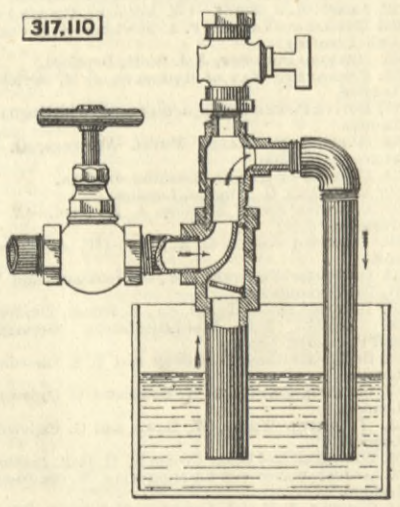


the grooved portion, the grooves forming a serrated edge and extending to the margin of the back portion, substantially as described.

317,110. INJECTOR CONDENSER, *Thomas Foulds, Trevorton, Pa.—Filed February 17th*, 1885.

Claim.—In a jet condenser, the combination of the tank with the supply pipe provided with exhaust nozzle, and the discharge pipe, the supply and discharge pipes being of equal length, substantially as and for the purpose set forth.

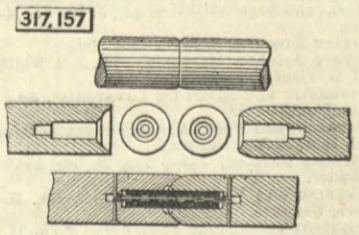
317,110



317,157. FLEXIBLE COUPLING OR JOINT FOR WOODEN RODS, *Harvey V. Lowrie, Denver, Colo.—Filed September 20th*, 1884.

Brief.—Rod sections with concavo-convex abutting ends internally chambered, and connected by a flexible chain and a flexible elastic coupling. *Claim.*—(1) The combination, substantially as hereinbefore described, of the wooden sections provided with concavo-convex abutting ends, and a central flexible elastic core, securely housed in both of said rod sections, and flexibly coupling them, as set forth. (2) The combination of the rod sections, internally chambered centrally, and longitudinally connected by a non-extensible flexible link or chain, and a flexible and elastic coupling, substantially as described. (3) The combination of the rod sections, internally chambered at their abutting ends, a flexible and elastic core snugly fitted within said sections, and a flexible but non-extensible link or chain within said core, and firmly secured at its ends to said sections, substantially as described.

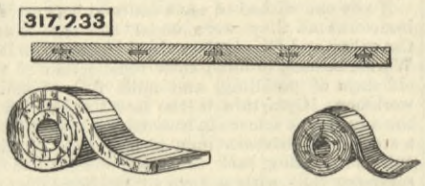
317,157



317,233. WOODEN TONGUE FOR JOINING FLOORING, &c., *Irwin H. Spelman, Cortland, Ohio.—Filed March 17th*, 1885.

Claim.—(1) A wooden tongue for joining flooring, ceiling, or other pieces of wood, with the grain of wood of the tongue running crosswise, substantially as set forth. (2) A wooden tongue for joining pieces of wood, and consisting essentially of a wooden strip approximately rectangular in cross section, with the grain of the wood running crosswise of the tongue, substantially as set forth. (3) A tongue for joining boards or other pieces of wood, and consisting essentially of two strips of wood applied flatwise to each other, a thread, twine, or equivalent laid lengthwise between the wooden strips, and the whole glued or cemented together, and so arranged that the grain of wood is crosswise of the tongue, substantially as set forth.

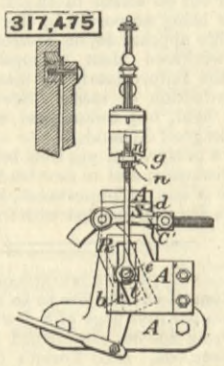
317,233



317,475. VALVE GEAR, *John B. Sutherland, Syracuse, N.Y.—Filed December 27th*, 1884.

Claim.—(1) In combination with the governor, valve stem, and excentric rod, the bracket A A^1, secured stationary in its position and provided with the guide groove *a* and slots *b b*, the slide S, moving in the groove *a* and having connected with it the valve stem, the rock arm R, connected at one end with the valve stem, and at the opposite end with the excentric rod and provided with the slot *t*, the fulcrum *e*, sliding into the slots *t* and *b b*, and the governor spindle connected with said slide, the rock arm R, connected at one end with the slide at the attachment of the link, and having connected to its opposite end the excentric rod and provided with the slot *t*, the fulcrum *e*, sliding in the slots *t b b*, and the governor spindle connected with said fulcrum, substantially as described and shown. (3) In combination, with the governor, valve stem, and excentric rod, the bracket A A^1, secured stationary in its position and provided with the segmental groove *a*, and vertical slots *b b* and *f*, the segmental slide S, moving in the groove *a*, the link C^1, connecting the valve stem with the slide, the rock arm R, connected at one end with the slide at the attachment of the link, and having connected to its opposite end the excentric rod and provided with the slot *t*, the fulcrum *e*, sliding in the slots *t b b*, the rods *c c*, connected at one end with the fulcrum *e* and guided in the groove *f* and screw-threaded at the opposite end, the cross-bar *g*, connecting the rods *c c*, nuts *n n*, for adjustably sustaining the cross-bar on said rods, the governor spindle having its end screw-threaded and passing through the cross-bar *g*, and nuts n^1 n^1 for adjustably connecting the governor spindle with the said cross-bar, all constructed and combined to operate substantially in the manner specified and shown.

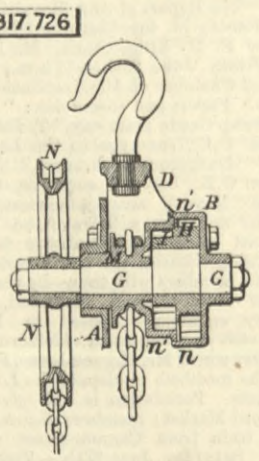
317,475



317,726. DIFFERENTIAL PULLEY BLOCK, *James Christie, Philadelphia, Pa.—Filed October 6th*, 1884.

Claim.—(1) The combination, in a pulley block, of differential gearing, substantially as described, with the frame consisting of the plates A and B and top piece D, constructed and secured to each other, substantially as set forth. (2) The combination of the frame consisting of the plates A and B and top piece D, with the differential gearing, the chain pulley M of which has a hub bearing in the plate A, and with the shaft G extending through and having a bearing on the said chain wheel, substantially as specified. (3) The combination, in a pulley block, of the within-described differential gear, in which the wheels H and I are combined with and contained within the internally-toothed wheels *n* n^1, the edge of one wheel overlapping that of the other, as set forth.

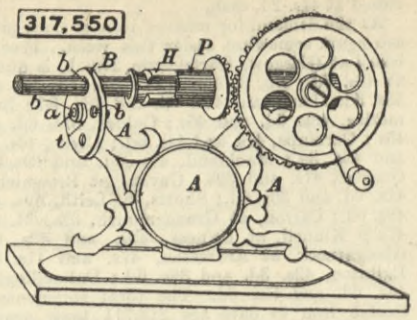
317,726



317,550. PENCIL SHARPENING MACHINE, *Warren H. Lamson, Lynn, Mass.—Filed September 29th*, 1884.

Claim.—(1) In a pencil sharpening machine, the combination of the holding plate B, provided with openings *b* for the pencil, and cavities *n*, with the frame A, having pin *h*, said plate being secured to the frame by screw *a*, and spring washer *t*, all the parts being arranged and operated substantially as described. (2) In a pencil sharpener, the combination of the chuck H, adapted to hold the sharpener, and the mandril D, secured together by a flexible sleeve P to admit of lateral movement, and means to revolve the same, substantially as described.

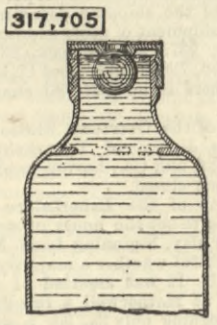
317,550



317,705. BOTTLE STOPPER, *William Beardsley, Beacon, Iowa.—Filed February 27th*, 1885.

Claim.—The combination, with the apertured cap fitted upon the bottle neck, of the apertured packing interposed directly upon the cap and the upper edge of the bottle neck, and provided upon the inner surface, around its aperture, with a pendent annulus or flange, and the ball valve, substantially as and for the purpose set forth.

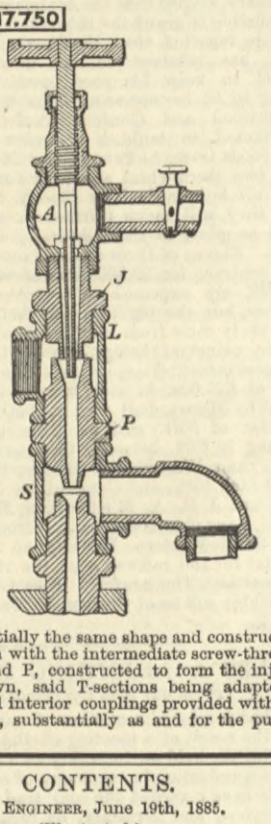
317,705



317,750. INJECTOR, *Frank C. Douds, New Castle, Pa.—Filed October 27th*, 1884.

Claim.—In an injector for steam boilers, the chamber consisting of the three interiorally screw-threaded T-coupling sections A L and S, hollow inside and of substantially the same shape and construction, in combination with the intermediate screw-threaded couplings J and P, constructed to form the injector tubes, as shown, said T-sections being adapted to receive the said interior couplings provided with connecting collars, substantially as and for the purpose set forth.

317,750



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