BUCKLING OF RAILS UNDER THE SUN'S HEAT.

By Professor A. G. GREENHILL.

RAILWAY engineers are well acquainted with the trouble given by a length of line in which the rails are placed end to end too closely, so as not to allow sufficient space for expansion under the varying temperature of the place.

This defect may arise either from the rails having been originally put in too closely, without leaving sufficient end space for expansion, or it may arise on an incline where the traffic is heavy and the brakes frequently applied, so that the rails are dragged down the incline, until they abut end to end closely together.

Then, when a hot day comes, the rails are not capable of expanding longitudinally, and so are compelled to buckle sideways; the line twists and goes crooked into a serpentine shape; and, I am informed by Mr. Mortimer Evans, and recent experience has shown, that accidents have happened before now on this account.

Supposing, then, that from any cause the rails fit accurately end to end, I propose to investigate the subsequent rise of temperature at which the straight form of the line becomes unstable, and the rails tend to buckle sideways, under the thrust due to the checked longitudinal expansion, employing the well-known theory of Euler on the stability and flexure of a straight column under a given thrust.

Taking Fahrenheit's scale of temperature, the inch as unit of length, and the gravitation unit of force the pound, then if L denotes the length of a rail, and l the elongation due to a rise of temperature $t°$ F.,

$$\frac{l}{L} = \alpha t,$$

where α = ·00000642, the co-efficient of longitudinal expansion of iron for 1° F.

But by Hooke's law—*ut tensio sic vis*—the thrust P required to bring the rail back to its original length L is given by

$$\frac{P}{K E} = \frac{l}{L},$$

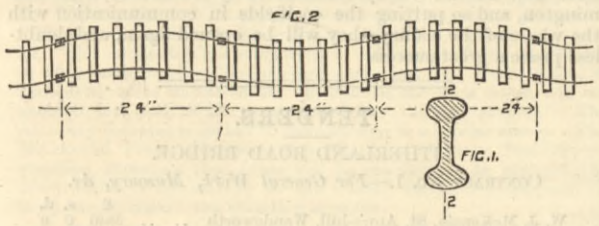
where K = sectional area of rail in square inches; and E = 29,000,000, Young's modulus of elasticity for wrought iron; so that $P = K E l \div L = K \alpha t$.

Now, by Euler's theory of the stability and flexure of a straight uniform column under a given thrust P—Unwin, "Machine Design," p. 62—the rail will begin to buckle when

$$\frac{P}{K k^2 E} = \frac{\pi^2}{a^2},$$

where a denotes the length of rail between two consecutive points of inflexion, and k is the radius of gyration of the cross section of the rail about an axis $z z$, perpendicular to the plane of flexure (Fig. 1).

FIG. 2



In consequence of the extra lateral flexural rigidity imparted by the fish-plates, we can begin by assuming that a is the length of a rail L, and that the points of inflexion are at the fish-plates; and then,

$$\alpha t = \frac{l}{L} = \frac{P}{K E} = \pi^2 \frac{k^2}{L^2};$$

$$\text{or, } t = \frac{\pi^2}{\alpha} \frac{k^2}{L^2},$$

giving t, the rise of temperature at which the rails will begin to buckle, after they once abut end to end; a result which is seen to be independent of K, the sectional area of the rail, and E, the modulus of elasticity of the material of the rail.

As a numerical example, take a 24ft. rail; then

$$L = 24 \times 12 = 288;$$

and we may suppose

k^2 = ¼, approximately;

then

log. k^2	= $\bar{1}$·39794,
log. π^2	= ·99430,
log. $\pi^2 k^2$	= ·39224;
log. L	= 2·45939,
log. L^2	= 4·91878,
log. α	= $\bar{6}$·80754,
log. αL^2	= $\bar{1}$·72632;

so that

log. t	= ·66592.
t	= 4·634 = 4·6, say;

so that an increase of 4·6° F. will cause 24ft. rails to buckle when once longitudinal extension is checked.

Then, if p denotes the longitudinal pressure, in pounds per square inch, in the rail,

$$p = \frac{P}{K} = E \alpha t,$$

and

log. E	= 7·46240,
log. α	= $\bar{6}$·80754,
log. t	= ·66592,
log. p	= 2·93586,
p	= 863.

The rails are then supposed to buckle, as shown in plan in Fig. 2, the undulations being shown to an exaggerated scale, F F . . denoting the position of the fish-plates.

It is found now-a-days with steel fish-bolts, screwed up with a long wrench, that the fish-plates sometimes grip the rails so tightly as to prevent longitudinal extension, and buckling will take place even when there is still room for expansion between the ends of the rails; careful instructions should then be issued to the platelayers to slacken the fish-bolts on a hot day. Otherwise the passage of a train over a straight piece of line will provide the predisposing cause of buckling, if the longitudinal expansion is ever so little checked.

But unless the fish-plates are screwed up very tightly, it might happen that the length of an undulation between two consecutive points of inflexion was the length of two rails, three rails, &c., when the rise of temperature required for buckling would be only one-quarter, one-ninth, &c., respectively of the above rise of temperature for the buckling of one rail length; so that the practical conclusion arrived at is, that the slightest rise of temperature will make a straight piece of railway line crooked, when once the rails fit tightly end to end.

It is important, therefore, that the distance allowed between the adjacent ends of the rails should be such that the rails do not touch under the highest temperature to be expected at the place; so that in climates like those of Canada and Russia, where the range of temperature between summer and winter is very considerable, the contraction of the rails under the lowest possible cold will, in consequence of the above precaution, cause the interval between the rails to be sufficiently great to render rapid running dangerous or unpleasant.

For instance, for a range of temperature of 180° F., the distance between two 24ft. rails at the lowest temperature would have to be about one-third of an inch.

Of course, no difficulty occurs on a railway curve from the above causes, because the expansion can be taken up by a slight increase of the curvature of the whole curve.

THE NEW SOUTH WALES RAILWAYS.

TOWARDS the end of last year[1] we made reference to the endeavour that was then being made by the New South Wales Government to carry through Parliament a Railway Management Bill, with the object of placing the railways of the Colony out of reach of the political influences which for years past have so seriously affected their administration. Although the expediency of doing so with as little delay as possible was unquestionable, the Bill made very little progress, and ultimately perished, after reaching its second reading, in consequence of a change of Government and a dissolution of Parliament early in the present year. We are glad, however, to say that, in view of the necessity for decisive action in this matter having come to be recognised by all political parties in the Colony alike, the new Ministry, under the premiership of Sir Henry Parkes, have introduced in the Legislative Assembly a fresh Bill purporting to carry out the main object of the previous one, although in a somewhat different manner. By the former Bill it was proposed to place the construction of new lines, as well as the maintenance and management of existing ones, under the charge of a Board of three Commissioners, who were to be practically independent of the Executive Government, notwithstanding that the Bill provided for the appointment of a minister nominally over them, to be styled "Minister for Railways," but whose province was not very clearly defined. The Bill now before Parliament proposes, on the other hand, to separate the "functions," as it terms them, appertaining to the management of the lines opened for traffic, together with the control and regulation of the staff in connection therewith, from the functions appertaining to the construction of new lines and the maintenance of the existing ones. The former functions it is proposed to place at once in the hands of a Board of three Commissioners, similar to that contemplated by the former Bill, the latter functions being left for the present under the jurisdiction of the Minister for Public Works. Possibly in this, as in other cases, "half a loaf is better than no bread," but the proposal to deal with only one of the two branches of the subject in the present Bill seems open to question. It certainly is not clear what is to be gained by it, while it is obvious from the inconsistency of some of the clauses of the Bill—as, for instance, those dealing with the appointment and removal of the engineering staff and the procedure to be followed by the Commissioners in connection with the maintenance of the lines, which by the preamble is to be separate from their functions—that the present Bill is incomplete, if, indeed, in these respects it be not actually impracticable, and that if it be not remodelled in important particulars, it must be speedily supplemented by a second one. Any supplementary Bill, however, dealing with such matters as the maintenance of those lines in the hands of the Commissioners for traffic purposes cannot fail to lead to a re-opening of questions affecting their jurisdiction.

Possibly the attempt to deal with the matter piecemeal, in place of by a single Bill, is dictated by parliamentary or ministerial convenience. Be that as it may, the position the Commissioners are to occupy as indicated by the Bill as it stands calls for remark, seeing that the status assigned to them will practically determine how far the management of the railways shall be really free for the future from political influence. It is certainly open to question whether the position proposed to be accorded to them is sufficiently independent of ministerial action. The Bill, it is true, provides that the Commissioners are to "hold office during good behaviour, and shall not be removable therefrom unless a recommendation of the Governor to that effect shall first have been laid before both Houses of Parliament, and have been affirmed by resolution in each House." This, so far as it goes, is well and good, notwithstanding that it is not quite reconcilable with a previous clause stating that their term of office shall be limited to seven years. The clause certainly adds that at the end of the seven years they shall be eligible for re-appointment for a like period. In reference to this periodical vacation of office, it may be remarked that it has the objection of giving opportunity for a Ministry, whose political supporters may not have received at the hands of the outgoing Commissioners the consideration or favours to which they may think themselves to have been entitled, to do those supporters a good turn by not re-appointing the retiring Commissioners; and as all Commissionerships might fall vacant at the same time, so far, at all events, as the terms of the Bill provide, the whole Board might be got rid of at once by a hostile Ministry. But there is another stipulation in the Bill which seems to require amendment. The clause we have quoted, providing that the Commissioners shall not be removable from office unless a recommendation to that effect shall first have been laid before both Houses of Parliament, and have been affirmed by resolution in each House, goes on to say:—"Provided always that when Parliament is not sitting, it shall be lawful for the Governor"—*i.e.*, as the Bill specifies, "the Governor with the advice of the Executive Council," which is in reality the Ministry themselves—"to suspend any Commissioner from his office for misbehaviour, and in any such case a full statement of the cause of such suspension shall be laid before both Houses of Parliament within seven days after the commencement of the next session thereof." It then adds:—"And if an address of both Houses shall within twenty-one days from the commencement of such session be presented to the Governor praying for the restoration of such Commissioner to his office, such Commissioner shall be restored accordingly, but if no such address be presented, it shall be lawful for the Governor"—acting, of course, on the advice of the Ministry—"to confirm such suspension, and to declare the office of such Commissioner to be, and the same shall thereupon be vacant." It will be seen that the first-named portion of the clause is positive in its operation, and provides that no Commissioner can be removed from office, or even suspended, as the clause implies, while Parliament is sitting, except by the "affirmation" of both Houses. The latter part of the clause, on the other hand, is negative in its operation, for it permits of the suspension of any Commissioner who shall have been suspended during a parliamentary recess being confirmed, and his office declared vacant, if no address praying for his restoration to office be presented within twenty-one days of the meeting of Parliament. Why a Commissioner who has been suspended during the recess of Parliament should be liable to be dismissed without the "affirmation" of both Houses, which is required before any action can be taken when Parliament is sitting, is not obvious.

But assuming the foregoing defects in the clauses of the Bill to be corrected, and the various provisions thereof to be brought into harmony with its avowed object, there remains for consideration an equally important, if not even more important, matter in its bearing on the proposed reforms in the Railway Department, and one which will demand the exercise of much care and judgment on the part of the Ministry on whom shall devolve the duty of carrying the Act into effect. That matter is the selection of those who are to fill the posts of Commissioners, for it is obvious that unless men of the right stamp be appointed thereto, no Act, however perfect in itself, would prevent the perpetuation of the existing evils. Following in this particular the example of the sister Colony of Victoria when the administration of her railways was put a few years ago on a non-political footing, it is not improbable that the New South Wales Government would obtain from this country, as one of the Commissioners, a gentleman thoroughly versed in railway management, whose experience would enable the Board to conduct the traffic of the railways in the most thorough and economical manner. One of the other Commissioners would, we presume, be qualified by technical experience to advise the Board on the engineering questions connected with the working and maintenance of the lines. The third Commissioner would, no doubt, be selected for his acquaintance with the local wants of those using the railways. There ought to be no difficulty experienced in finding in this country a man well qualified for the first-named Commissionership, provided the salary offered be sufficient to attract men of the necessary experience and ability. In the filling up of the post of technical Commissioner recourse would doubtless be had to the Colony itself. Possibly no one is as well qualified for the position as the present Engineer-in-Chief for Railways. His long experience in the Colony and the confidence which the Government, as represented by Sir Henry Parkes, as well as the public at large, place in his integrity and judgment, would be of invaluable service to the Board. His services as consulting engineer could at the same time be made available by the Government on questions connected with the laying out of new lines. The third Commissionership would also, no doubt, be most fitly filled by some one resident in the Colony, who has had large and varied experience in regard to its internal trade and commercial wants, and who is at the same time free of all connection with political parties.

We believe that it only requires freedom from political influence in the selection of new extensions, and able and upright administration of the existing lines, to insure such a success in connection with the splendid system of railways which, taken as a whole, the Colony possesses, to enable them not only to pay their way, but to yield a substantial contribution to the public revenue.

[1] THE ENGINEER, vol. lxii., page 429.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

New South Wales—New tariff: effect on American trade.—The United States Consul at Sydney reports:—Besides the specific duties, the 5 per cent. *ad valorem* duty levied on a very large number of articles which affect American trade in several directions will operate much more injuriously than the amounts would seem to indicate, for when competition is carried on against local industry, an addition to the cost of only 5 per cent. will often turn the scale against imports. This will probably be most apparent in such articles as buggies, carriages, carts, carriagemakers' materials, machinery, wagons, &c. In regard to the 5 per cent. *ad valorem* tax on machinery, much dissatisfaction is expressed, especially as the cost of American machinery hitherto has been high, and the people prefer it to any other,

and it is daily becoming more popular. It is gratifying to note that the American locomotives recently introduced into Australia have given very general satisfaction; and it is not unreasonable to expect that they will soon supersede all others. Until recently the Australians seemed to think that the old-fashioned English locomotive, built upon the lever-motion principle, was the perfection of mechanical ingenuity, ignoring all the improvements made by the Americans in locomotives during the last forty years. Now the people are beginning to understand that the English engine is too clumsy and heavy, and that it must give way to the American one. It has been noted that the English locomotive wears out too rapidly, and does great injury to the roadway. A recent report of the Commissioner of Railways in New Zealand states that the American locomotives in that Colony have more than realised what was expected of them. "The American engines have proved themselves to be both economical and good, and for attention to detail in design and general excellence in workmanship they stand out first in our catalogue of locomotives. American engines I thoroughly believe to be more suited to our lines than anything we can get from England." The American engines in New South Wales are quite as well appreciated as in New Zealand, and Mr. Thomas Higginbotham, engineer-in-chief of the railways in Victoria, is a staunch advocate for their use. In a recent report he states:—"I did not go to the States at all prepossessed in favour of American engines; but what I saw there satisfied me that for the light railroads of this country they are better adapted than any other kind." American machinery and appliances for bridge building are also likely to supersede all others. The contract for the construction of the new railway bridge across the Hawkesbury river in New South Wales was awarded to the Union Bridge Company of New York. The construction of this bridge, on account of the great depth of foundation, involving some of the most difficult questions known to science, and the skill thus far displayed in its construction, and the rapidity with which it has been pushed forward, has attracted the admiration and attention of everyone interested in the prosperity of the Colony. The English engineers in building bridges still adhere to the practice of rivetting the pieces, instead of fastening them together with pins as in America. The former plan takes about as many weeks as the latter does days, and does not give half the satisfaction. Another difference between the two methods of bridge building is that the Americans make bridges in workshops and spend little time in putting them up; whereas the English do most of their work on the banks of the stream where the bridge is wanted, but where they have not the steam rivetters and other labour and time-saving appliances to be found in the shops.

Tariff.	£	s.	d.
Bolts, nuts, rivets, screws, spikes—pointed or flat—bolt rings and washers—plain or galvanised metal—per ton	2	0	0
Galvanised iron, corrugated, bundles, bars, or in sheets, per ton	2	0	0
Galvanised manufactures, per ton	3	0	0
Iron chains not otherwise exempted, per ton	1	0	0
Iron safe doors or safes, per ton	3	0	0
Iron or steel wire, per ton	1	0	0
Lead, pipe, roll, or sheet, per ton	2	0	0
Nails	2	0	0
Zinc manufactured or perforated	3	0	0

And upon all other articles imported into the Colony and not enumerated above or in the free list for every £100 on the value thereof the sum of £5.

Goods declared free of customs' duties:—Anchors, chain cables—iron—not less than ½in. in diameter, clod crushers, copper ingots, field rollers, harrows, hay rakes, horse-hoes, mowers, reapers, iron, bar, bundle, hoop, old pig, plate, rod, scrap and sheet lead, pig, metal, old sheets and yellow, nails, yellow metal, ores, thrashing machines, tin ingots, thrashing machines, zinc, plain sheet.

United States—Trade of Chicago in 1886.—Manufacturers of iron and steel from foreign countries cannot, as a general rule, compete with the home product, especially as regards heavy goods, on account of the high rate of duty. There is a constant demand for cutlery, needles, razors, and other fine goods from Great Britain. Whatever steel rails may have been imported from England, on account of the late unusual demand in this district, must have been owing to the demand exceeding what local mills can deliver at a required time. The present price of steel rails here is £7 12s. 7d. per ton; and of pig iron, charcoal, £4 19s.; soft fluid, £4 10s. 2d., and wheel, £6 18s.; while there is a duty upon English rails of £3 10s. per ton. Consequent on the extension of railway building, the demand for steel rails has been unusually great, and has created much activity in all branches of the iron trade. There are now rail manufactories in most of the Western States, and ironwork of any description, cast, rolled, and wrought, is actively carried on. Iron and steel industries are bound to increase round these great coal and iron districts, and the more the country is opened out the more important will all industries become. The State of Illinois, though the iron found is not commercially important, has the advantage of inexhaustible supplies of coal, and is surrounded by the rich iron districts of neighbouring States. The furnaces and rolling mills of Chicago, South Chicago, and Joliet, have become very extensive, and yearly increase their output. In 1886 the product of ingots of Bessemer steel in this State was 535,692 tons, against 366,659 tons in 1885, and of these 436,075 tons were converted into rails for 1886, against 308,242 in the preceding year. The six rolling mills in Chicago are in full work, and have contracts to last them through the summer; their output in 1886 is estimated at £2,500,000. The output of the four car wheel works, forty foundries, and fifty-eight machine works in Chicago, was £940,000, £1,750,000, and £1,250,000 respectively. The production of pig iron was 750,000 tons at an all round price of £3 16s. 11d. per ton, and prices have been rising throughout the year. The total value of the iron and steel manufactures of Chicago in 1886 was £9,650,000. There are about 21,000 men engaged, and wages at the rolling mills have risen nearly 15 per cent. The manufactures of agricultural implements, carriages, railway cars, and wagons, have been exceedingly active, the output of the former being valued at £3,000,000. Planing mills, furniture manufactories, and all woodwork establishments, show also a large increase this year, but these, as well as the iron and steel trade, are not confined to Chicago, and are rapidly developing in other cities of the district. The various mines in this district have been in constant work, fresh ones have been discovered and opened, and the mineral wealth of Colorado, Dakota, and Montana, is constantly increasing. Among the metal products of Montana in 1886 was copper, to the value of £1,650,000, and lead to the value of £256,000. The discovery of tin in the Black Hills of Dakota is attracting much attention, the supply of that mineral being dependent on importation. The mining industries of Wyoming are commencing to develope, though as yet there are no manufactures, and lubricating oil springs of very high quality have lately been discovered; while petroleum exists over a vast extent of that territory. Valuable discoveries of iron, making the best Bessemer steel, have lately been made in the Gogebic range, in the north of the State of Wisconsin, some sixty miles east of Ashland, and about forty mines have commenced work. A large amount of capital has already been invested, and the discovery of these mines has had a direct influence on the prosperity of Milwaukie, where they are chiefly owned. Miners have been greatly in request at from 7s. to 10s. a day, and the cost of living is low. Coal is the principal mining industry of the State of Illinois, and employs 26,000 men. The output was in 1884, 9,500,000 tons. The controversy between mine operators and miners seems to rest for solution on the payment of all coal sold, the prevailing system here being that screened coal only is paid for, and not what passes below the screen.

United States—Progress of Saint Paul.—The many-sided growth of St. Paul in the last twelve months is one that has never been surpassed in the history of marvellous development in the Western World. There are here 150,000 people, and adjoining St. Paul is the city of Minneapolis, with an equal population. No better indications of the prominence which the manufacturing interests of St. Paul have attained can be given than are shown by the statistics of their growth in the past. In 1876 there were eighty-eight establishments, employing 985 hands, and having a production of £335,700. In 1885 the figures were—establishments 864, number of hands 17,581, and value of production £6,132,708. The statistics for 1886 are not yet tabulated, but as far as examined they indicate an increase over 1885 in all the above items, of from 15 to 20 per cent. The new manufactures established here during 1885 are the Bohn Manufacturing Company, employing from 254 to 400 hands, and having a capital of £52,000; the Devane Foundry Company, with a capital of £4200; the Edison Electric Light and Power Company, capital £42,000; the Holland and Thompson Brass Works, capital £15,600; the Warner and Hough Machinery Company, capital £10,400; the Waterous Engine Company of Winnipeg, capital £20,800; and a large undertakers' manufacturing establishment, capital £20,800; with numerous other concerns of less note, the whole capital of these additions to the city's productive industries amounting to over £8,300,000. The proximity of St. Paul to the wonderful iron ranges of Minnesota and Wisconsin, the low rates of transportation, growing out of the sharp competition of rival lines, and the favourable conditions of the fuel question, all tend to favour here the establishment of the various branches of the iron industry. Whether the organisation of smelting works be yet practicable or not, it is certain that the promotion of secondary industries, resulting from the reduction of ores, is a living issue, and steps are being taken to enlarge the class of manufacturers. The production of boilers, engines, forge and lathe works, mill machinery and railway appliances, will soon be entered upon. The necessities of the railway works centred here will compel the establishment of car works in the near future. The importance of St. Paul will be better understood when it is known that the new iron mines in the Gogezic district are but sixty-three miles distant by railway. The Legislature this year passed a law which, if proved constitutional, will affect many British holders of real estate. The statute is entitled an Act to restrict the ownership of real estate in Minnesota to American citizens, and to limit the quantity of land which corporations may acquire. Section 1 enacts that no persons who are not, or have not signified their intention to become American citizens, or any corporations not created under the laws of the United States, or some State or territory thereof, shall hereafter own any real estate in this State, except such as may be acquired by decree or inheritance, or in the ordinary course of justice in the collection of debts hereafter created. The prohibition of this section shall not apply in such cases, as the right to hold lands in the United States is secured to the subjects of foreign countries by existing treaties so long as the treaties are in force. The prohibition is not to apply to settlers upon farms of not more than 160 acres, who may settle thereupon before 1st January, 1889. Section 2 enacts that no corporation, over 20 per cent. of its stock being owned by associations or persons not citizens of the United States, shall own any real estate in Minnesota. Section 3 enacts, that no corporation, other than those organised for the construction or operation of canals, railways, or turnpikes, shall own over 5000 acres of land, and no canal, railroad, or turnpike corporation shall hereafter hold more land than is necessary for the proper operation of its canal, railroad, or turnpike, except such lands as may have been granted to it by the Act of Congress, or of the Legislature of the State. Section 4 enacts that all property held in violation of this Act shall be forfeited to this State. The Act is to take effect from the 1st July, 1887. "I have not yet obtained legal opinion as to its constitutionality, but in my opinion it conflicts with the constitution of the United States."

United States—Manufactures and minerals of Tennessee.—Manufacturing since 1875 shows a vast increase. In 1850 the number of establishments of all kinds was 2887, with a capital of £1,360,000 and a production of £2,026,200. In 1886 the number of manufactories had risen to 4425, with a capital of £8,492,800, and a production of £15,670,000. Each succeeding year witnesses the penetration of the coalfields by new entries, the opening of new beds of iron ore, the erection of new iron furnaces, coke ovens increased in numbers, the construction of iron foundries of all descriptions, the erection of additional furniture and lumbering establishments, the building and enlarging of cotton and woollen factories. Besides these manufactories, those of cotton, wool, ploughs and wagons, cotton-seed oil and cake fertilisers, furniture, tin and sheet iron ware, stove and other foundries, grist and flour mills, show great activity and progress. Labour is plentiful and regular at reasonable prices, and no stoppages by reason of extremes of cold or heat occur. The chief minerals found in Tennessee are coal, copper, iron, lead, manganese, and zinc. Barytes, fireclay, hydraulic rock, marble, and millstone grit, are also abundant. Petroleum has been discovered in several districts, but for the want of cheap transportation has not been developed. Coal which is considered excellent for all purposes is found throughout the State, is free from slate or sulphur, and outcropping on hill slopes or mountain sides, the mines are well situate for entry by drifts, and cheaply and easily drained, ventilated, and worked. The output of coal and coke in 1886 was 1,100,000 and 268,400 tons respectively. The production of the mines at present is consumed in the State. The copper mines have been worked since 1850. About £1,250,000 capital is employed in its production, and in 1880, 69 tons was produced and shipped. Iron ore, magnetic and red and brown hematite, are found throughout the State, and their good qualities are generally known and being rapidly developed; iron is now made at a cost of from £2 10s. to £3 6s. 8d. a-ton. From this iron a very pure quality of steel is made. The quantity of iron produced in 1885 was 326,040 tons, which was exported to the north and west. Manganese is found in considerable quantities, and being used in the manufacture of steel, the mines have been worked a good deal, and it promises to become one of the most useful and valuable of the Tennessee minerals. Zinc is also found, and in 1884 17,415 tons were produced. The State of Tennessee is dependent upon other countries and States for the finer cotton and woollen fabrics; white goods, hardware, cutlery, boots, shoes, chemicals, machinery, sugar, salt, coffee, tea, glass, paints, rice, &c., and in all probability even with the high rates of duty of the United States tariff, if British manufacturers would send agents to Chattanooga, Memphis, Nashville, and other towns in the State with samples of English goods, they might obtain orders for the same and find the undertaking profitable.

United States.—Minerals of North Carolina.—There has not been a time in the history of North Carolina when so much attention has been directed to her mineral wealth as at present. The inquiries from abroad are numerous, and it is estimated that the Museum at Raleigh is visited daily by twenty or more persons in quest of information and inspection of specimens of minerals. There are indications that the mining operations will be largely augmented at an early day, and that the rich treasures of North Carolina will ere long make her the leading State of the South. Copper ores are found in many localities in the State. The principal deposits are in Alleghany, Ashe, Cabarrass, Granville, Guilford, Mecklenburg, and Puson counties. Messrs. Clayton and Co. have 600 men at work at Oreknob Copper Works, in Ashe County; average of ores, 20 per cent. copper. The Conrad Hill Mine, in Davidson County, is successfully worked by 130 men; copper assays from 5 per cent. to 30 per cent. Iron is found in considerable quantities in thirty counties in the State. The iron regions of Chatham, Granville, Guilford, and Stokes County, being to the north of the centre of the State, in convenient distance of the coal fields. The deposits of Catawha, Gascon, and Lincoln Counties lying to the west of the centre on the southern border, with beds like those of Big Ore Bank and Yellow Ridge, reported to run to a thickness of 16ft., 18ft., and even 40ft. In the north-west corner of the State, in Ashe, Caldwell and Mitchell Counties, is the famous Cranbury deposit, fabulous in thickness and entirely free from phosphorus and sulphur. In Cherokee County, in the extreme south-west corner of the State, are deposits of limonite ore, said to be of great thickness. The ores of Chatham County show 58 per cent., those of Cherokee County 60 per cent. of metallic iron. The percentages of metallic iron average:—In Davidson County, 37; in Gaston County, from 52 to 67; in Guilford County, 55; in Mitchell County, 65; in Stokes County, 65; and in Watanga County, 67. The hematite ores of Granville and Halifax Counties show 63·76 per cent., and the limonite ores of Duplin and Nash Counties, 42·73 per cent. of iron. Some of the mines were worked during the revolutionary war, and many worked more or less ever since. Several new lines of railway are now in course of construction which will open up many of the mines which have lain dormant so many years for want of proper transportation facilities. Manganese is found in large quantities in Aslu, Lincoln, Madison, and Suny Counties. Tin-stone has been found at King's Mountain, appears to be abundant, and contains from 45 to 75 per cent. of metallic tin. There are two coal districts in the State, mainly in Chatham and Stokes Counties, the former being called the Deep River district and the latter the Dan River district. The area of the Deep River district is estimated at 300 square miles, and the analysis is—Volatile matter, 31·30 per cent.; fixed carbon, 64·40 per cent.; ash, 4·30 per cent.; total, 100·00. These mines were worked for several years very successfully. The coal was transported by rail to Fayettville, N.C., and thence by water to Wilmington, N.C., which necessitated such an expense for handling that the operators, not being able to compete with other markets, discontinued working the mines. Now that the Cape Fear and Tudkin Valley Railroad is to be extended to Wilmington, and so putting the coalfields in communication with the whole of the county, they will be opened again, and doubtless prove a great success.

TENDERS.

LITHERLAND ROAD BRIDGE.

Contract No. 1.—*For General Work, Masonry, &c.*

	£	s.	d.
W. J. McKenzie, St. Ann's-hill, Wandsworth	3840	0	0
Sayce and Randall, Appleton, Widnes	3360	0	0
George Smith and Co., Southport	2937	0	0
Holme and King, Liverpool	2849	9	4
John Riddell, Birkenhead	2768	2	0
F Dovener, Edge-lane, Liverpool	2629	0	0
Richard Oates, Exchange Station, Liverpool	2618	0	0
Geo. Parkinson, Manchester	2420	19	0
George Woods and Son, Bootle	2390	0	0
Wm. Hope, Earle-street, Liverpool (accepted)	2372	11	2

Contract No. 2.—*Engineering Work.*

	£	s.	d.
Stockton Forge Company, Stockton-on-Tees	2058	8	0
Matthew Pitts, Stanningley, Leeds	1912	0	0
Shewell and Co., Darlington	1689	13	4
Butterley Iron Company, Alfreton, Notts	1678	11	7
Holme and King, Liverpool	1605	17	0
Braithwaite and Kirk, West Bromwich	1575	0	0
Goddard and Massey, Nottingham	1350	0	0
Marsh Bridge Company, Workington	1349	16	0
Canada Works Engineering Company, Birkenhead (accepted)	1309	0	0

LAUNDRY AND MARRIED COUPLES' QUARTERS, ST. MARYLEBONE WORKHOUSE.

List of tenders for the erection of a new laundry and married couples' quarters at the St. Marylebone Workhouse, Northumberland-street, W., for the Guardians of the Poor of the Parish of St. Marylebone; H. Saxon Snell and Son, architects, London:—

	Married couples' quarters.	Laundry, &c.	Total for both works.
	£	£	£
J. and J. Greenwood	1758	6798	8495
C. Batcheldor	1749	6761	8410
Colls and Sons	1713	6640	8238
W. Scrivener and Co.	1660	6594	8177
J. Mowlem and Co.	1659	6597	8152
W. J. Adcock	1651	6576	8130
J. J. Robson	1643	6549	8103
Hall Bros. (accepted)	1592	6475	7975

Lord Armstrong.—The President, Edward H. Carbutt, Esq., and Council of the Institution of Mechanical Engineers, have sent a letter of congratulation to Lord Armstrong, as a past-president of the Institution, upon the occasion of his recent elevation to the Peerage. This being the first instance in which a mechanical engineer has been so signally honoured, the Council express the great gratification felt by the members of the Institution that the honour has been conferred upon one of their past-presidents, who, by his distinguished attainments in the profession of mechanical engineering, has already contributed so largely to the dignity and importance of the Institution. Lord Armstrong has been a member of the Institution for thirty years, and occupied the presidential chair for three years—namely, in 1861 and 1862, and again in 1869. In addition to his three presidential addresses, in each of which the then phases of the question of guns and armour plates naturally occupied a conspicuous place, he also contributed the valuable results of his experience and practice in regard to hydraulic machinery, in connection with which branch of engineering his name has acquired a celebrity rivalling, if not surpassing, that due to his achievements in gunnery.

RAILWAY MATTERS.

AT the meeting last month of the Master Mechanics' Association, the Hon. Charles D. Kerr, President of the Common Council of St. Paul, Min., referred to the great importance of railroads in opening up the State of Minnesota, which, young as it is, has over 4000 miles of railroad in operation. He stated that there were but 39 miles of railroad in the State twenty-two years ago.

INTELLIGENCE has been received that the Chamber of Commerce of Hong Kong has held a special meeting to consider the subject of the establishment of a mail service *vid* Canada, and has telegraphed to the Chancellor of the Exchequer its strong desire to see the proposals of the Canadian Pacific Railway adopted. Resolutions of a similar character have been adopted and transmitted to the Government by the Chambers of Commerce of Shanghai, Foochow, Amoy, Robi, and Yokohama.

THE Duke of Devonshire having resigned the chairmanship of the Furness Railway Company, owing to declining health, the directors have unanimously appointed the Marquis of Hartington to the position. The duke will retain his seat on the board of directors. The Marquis of Hartington is now chairman of the directorate of the Barrow Hematite Steel Company, the Barrow Shipbuilding Company, and the Furness Railway Company, thus being identified with all the large commercial and industrial interests of Barrow.

AT the ordinary monthly meeting of the Council of the Railway and Canal Traders' Association, held on Wednesday, the following resolution was unanimously adopted: — "That the Council strongly object to the proposed reference of the Railway and Canal Traffic Bill to a Select Committee, and they trust that the Government, by reasonable concessions to the views expressed on behalf of traders and agriculturists on the subjects of undue preference to foreign produce and the proposed allowance of station terminals, will provide for a discussion of the Bill in Committee of the whole House."

A SOMEWHAT singular occurrence took place as the Cologne Berlin express train was derailed near the Mülheim Station a few days since, and some five or six coaches upset—namely, that in consequence of the Carpenter brake becoming injured, such an impenetrable cloud of dust, enveloping everything, was created by it that it was some minutes before the carriages could be distinguished in order to release the half-suffocated passengers. No fatal accident occurred, but many were slightly injured, amongst them a young Englishman whose knees were damaged. It was within an ace of being a tremendous collision.

THE ox wagon is again to the fore in some parts of South Africa as a competitor for the carrying trade. Indeed, the *Colonies and India* says:—"It seems likely to beat the steam engine off the road between Port Elizabeth and Graaff-Reinet. There are those who will remember it was vaunted as a great stroke of policy by the late Mr. Patterson to have obtained two lines out from Port Elizabeth; but every year shows more and more clearly that it was a stupendous blunder. And yet in reality the harm done is not entirely because Mr. Patterson was mistaken, but partly because he is unfortunately dead. He was a man who had large ideas and much energy, and, if he had lived, the Graaff-Reinet line might not have proved a failure, because he would never have rested till he had got it extended westward. Certainly he would never have advocated the construction of that line if it was merely to run through a desert to Graaff-Reinet and no further."

THE excitement in connection with the disallowance by the Dominion authorities of the charters passed by the Manitoban Legislature for establishing railway communication between Winnipeg and the United States frontier is increasing. The Hon. John Norquay, the Premier, in the course of an interview, is represented, the *Colonies and India* says, to have expressed himself as follows:—"The railway will be built, no matter what the consequences may be. The contractor has everything in readiness to begin operations in the coming week. We are not serfs, and will not be found in the background in the event of trouble, which I hope will be avoided, but not at the expense of the railway project." The Attorney-General is stated to have spoken in a similar strain. The Ministerial Press, discussing the Manitoba Railway disallowance question, threatens that force will be resorted to to prevent the construction of the railway to the United States frontier, and all the journals regard the situation as acute.

CONCERNING the Railway Rates Bill, Mr. Heneage asked the First Lord of the Treasury in the House on Thursday, what course the Government proposed to take, and whether, considering that a similar Bill was fully discussed and read a second time in that House last year, and that the present Bill had been sent down from the House of Lords, the Government would endeavour to obtain the second reading at an early date in order that it might be sent to a Select Committee with a view to its becoming law during the present session. Mr. W. H. Smith said if the House would accept the suggestion of the right hon. gentleman to read the Railway Rates Bill a second time, and refer it to a Select Committee with a view to its becoming law this session, he should be glad to do all in his power to afford facilities for the purpose. Mr. Mundella doubted whether it would be satisfactory to refer so important a measure to a Select Committee in the month of July. He for one would be unwilling to serve on a committee appointed at such a time. Mr. W. H. Smith said that if the House desired that the course suggested in the question should be taken he would be glad to facilitate it. Of course, if the right hon. gentleman, who had special knowledge of the subject desired to delay the progress of the measure, he could oppose the course which was suggested. Mr. Mundella disclaimed any desire to delay the Bill. He thought the House knew something about the interest which he took in the measure, and desired that the House should get on with it, but believed that the course proposed would prevent the due discussion of it.

THE Russian *Official Messenger*, speaking of the works on the Transcaspian line, says:—"In 1886, the Transcaspian Railway line commenced upon the eastern shore of Gulf Mikhailovsky, at the station of Mikhailovskoe-Turkmenskoe. The shallowness of this gulf made it accessible only to vessels with a very small draught of water, and the sinuosities of a canal 40 versts long, marked out by a double row of stakes, was a serious obstacle to navigation. As a rule, the passengers were obliged to get out of the train at Krasnovodsk and get on board a small vessel, which could only travel by daylight, all this causing a great loss of time and considerable expense. In order to facilitate communications with the Transcaspian Province, it therefore became necessary to prolong the railway line to a point along the coast which could be reached by vessels with a deep draught of water. The Bay of Krasnovodsk answered these requirements, but the road leading to it was some distance from Mikhailovskoe, and very hilly, so that a railway in this direction would have been very dear. The result of an exploration made by the order of General Annenkoff went to show that in the vicinity of the island of Uzun-Ada, upon the route leading to the Bay of Mikhailovsky, there was a bay which, with a very slight outlay for dredging, would answer all purposes. The work was soon effected, and a small town named Uzun-Ada has already been built upon the southern coast of the Dardja Peninsula. This has already proved of considerable service, in that it has enabled the engineers to receive from Astrachan, without break of bulk, all the materials required for the construction of the Amu-Daria line. As the canal leading to Uzun-Ada is very narrow and sinuous, it has been marked out with a double row of posts, to which are attached lanterns lighted with photogene. The whole Transcaspian line, from the station of Uzun-Ada to the Amu-Daria, has a total length of 1011 versts, of which 794 were constructed in a little more than a year. All the materials were brought down the Volga from Astrachan. At present the regular trains run upon the new line twice a week."

NOTES AND MEMORANDA.

A SUBSTANCE resembling ivory, of creamy whiteness and great hardness, is made from good potatoes washed in diluted sulphuric acid, then boiled in the same solution until they become solid and dense. They are then washed free from the acid and slowly dried. This ivory can be dyed and turned and made useful in many ways. The artificial ivory that will receive and retain a polish has not, however, yet made its appearance.

DURING the cutting of peat in a moss at Vevang, near the town of Christiansund, in the north-west of Norway, the workmen recently dug out a log of oak over 12ft. in length, and about 4ft. in diameter, It was found at a depth of 9ft. The trunk and root of a great oak-tree were unearthed in the same moss some years ago, so we may conclude that there was once an oak forest on this spot. The remains of the oak were found below a layer in the bog in which remains of firs are often found.

THE mean daily motion of the air at Greenwich in 1886 was 291 miles, being seven miles above the average of the preceding nineteen years. The greatest daily motion was 857 miles on December 8th, and the least, fifty-six miles, on October 8th. The recorded pressures in 1886, exceeding 20 lb. on the square foot, were 27·6 lb. on March 31st, and 23·5 lb. on December 9th. During the year 1886 Osler's anemometer showed an excess of about seventeen revolutions of the vane in the positive direction N., E., S., W., N., excluding the turnings which are evidently accidental.

IT frequently causes much trouble, indeed, in some cases defies all efforts to free iron from ingrained rust, but according to a German paper the thorough cleansing of it may easily be effected by immersing the article in a nearly saturated solution of chloride of tin, even if much eaten into. The duration of the immersion will depend upon the thicker or thinner film of rust; in most cases, however, twelve to twenty-four hours will suffice. The solution of chloride of tin must not contain too great an excess of acid, otherwise it will attack the iron itself. After the articles have been removed from the bath, they should first be washed in water and then with ammonia, and be dried as quickly as possible. Articles treated in this manner assume the appearance of dead silver.

IN some researches on the heating and cooling of cast steel, by Osmond, the phenomena which accompany the heating and cooling of cast steel were investigated by means of a thermo-electric couple connected with an aperiodic galvanometer. Barrett observed that when a bar of hard iron is cooled from a white heat there is a sudden development of heat at dull redness, and the magnetic properties of the iron change abruptly. He distinguished this phenomenon by the name recalescence. Chatelier and Pinchon found that at about 700 deg. a molecular modification of pure iron is formed. The author's experiments show that as the proportion of carbon increases from 0·16 to 1·25 per cent. the temperature at which the molecular alteration takes place falls, whilst the point of recalescence rises, until in hard steel the two points coincide.

PROF. CHRISTENSEN, of Copenhagen, has recently made a redetermination of the atomic weight of fluorine, with, says *Nature*, the satisfactory result that this element is to be added to the already large list of those whose atomic weights are whole numbers and simple multiples of that of hydrogen. The determination was based upon the analysis of a double fluoride of ammonia and manganese, $4NH_4F \cdot Mn_2F6$, the extreme precautions displayed in the preparation and purification of which show the peculiar difficulties attending work upon this singular element. It is very interesting to read of the filtrations through platinum gauze placed in gutta-percha funnels, of the drying of the beautifully-crystalline red salt spread out upon wide expanses of platinum-foil, and of the skilful manner in which all traces of silicon were eventually eliminated. The results of the numerous analyses show that, if Stas's value for oxygen be taken as the standard, the atomic weight of fluorine is 18·94, but if, as Mendelejeff concludes, oxygen be 16, then the atomic weight of fluorine becomes 18·99, or, in round numbers, 19·0.

THE *New York Commercial News* describes two wine casks that are made from wood more than 1600 years old, to be seen in the cellars at 20, Dey-street, of Reichardt and Dietz, that were landed at Jersey City from the Rotterdam steamship Schiedam. They were made in Mainz, Germany. "It appears that the wood of which the casks in question are made was formerly part of the foundation piles of a bridge that was built over the river Rhine at Mainz, under Trajanus 99 to 117 and Maximus 235 to 238 years after Christ. The bridge was in later centuries destroyed by fire and all traces of it were lost until 1881, when excavations were made in the bed of the Rhine for the foundations of the present stone bridge between Mainz and Kastel. Then these ancient timbers were brought to light. It is probable that more than 2000 years have elapsed since the wood formed part of trees that reflected the sunshine and drank in the morning and evening dews of the old time world." Mr. Reichardt was in Europe last year, and made it a special point to secure some of these ancient timbers. They are ornamented with figurative carvings and with busts of the two Roman Emperors named—copied from ancient coins now in the museum at Mainz.

AT the last meeting of the Physical Society Prof. W. E. Ayrton, F.R.S., and Prof. J. Perry, F.R.S. read a note on "Magnetic Resistance." In the spring of 1886 the authors made experiments on the magnetic induction through horse-shoe electro-magnets when excited by constant currents. The inductions through different armatures and air spaces were also measured. The results show that for small exciting powers, the law of parallel resistances is true for magnetisms, taking leakage into account. From experiments made with two electro-magnets the poles of which were placed at different distances apart, the authors conclude that the magnetic resistance of air is proportioned to length, or to length plus a constant. A note on "Magnetic Resistance" was read before the Society on the 12th March, 1887, by the same authors, describing experiments on two iron rings, one whole and the other divided by a radial saw cut. Since then the experiments have been repeated with great care by Col. Swinton and Mr. Sorënson, of the Central Institution. The resulting curves agree with those previously obtained. On measuring the air space it was found considerably less than estimated, and the magnetic resistance of air relative to iron—assuming no surface resistance—comes about 1500. Experiments made with different air spaces together with the above seem to show a considerable surface resistance.

IN an article on "Products from the Cowle's Electrical Furnace," by C. F. Mabery—*Amer. Chem. J.*—it is stated that during the reduction of corundum a not inconsiderable amount of aluminium is volatilised, but this is prevented to a considerable extent by conducting the reduction in presence of heavy metals, such as copper, iron, or tin. The slag produced is principally an aluminate of calcium, formed from the lime used in preparing the charcoal lining of the furnace. The copper aluminium alloys contain $\frac{5}{6}$ per cent. of crystallised silicon, and also calcium up to 3 per cent. Iron cannot be made to alloy with as large a proportion of aluminium as copper, usually the alloy contains only between 6 per cent. and 10 per cent., with 2·5 per cent. of silicon and 2·5 per cent. to 3·7 per cent. of carbon. Such alloys possess valuable properties for foundry purposes, and are available for introducing aluminium into steel. Sand is readily reduced, and copper will dissolve the silicon to the extent of 14 per cent.; the addition of small quantities of silicon increases the tensile strength of certain metals; thus the tensile strength of aluminium bronze—100,000 lb. to the square inch—is increased to 120,000 lb. by the addition of $\frac{1}{2}$ per cent. of silicon. When silica alone is reduced an amorphous greenish substance is found between the silicon and the silica; it is difficult to obtain pure, but from its mode of formation, properties, and the results of its analysis, is evidently silicon [illegible] oxide.

MISCELLANEA.

IT is stated that the number of passengers carried by the 777 omnibuses of the London General Omnibus Company during the fortnight ending 26th ult. was 4,476,414.

WE learn that Mr. Adolphe Greiner, chief engineer and manager of the steel works of the John Cockerill Company, has been appointed director-general of the company, in place of Baron Sadoine.

IN our notice on the 17th ult. of the launch of the s.s. Emden, we omitted to mention the fact that the Lancaster spiral pistons are working in the engines a brief description of which we gave.

DURING June, 17 vessels, of an aggregate of 16,725 tons were launched from the Clyde shipyards as compared with 19 vessels of 17,073 in the same month of 1886. The output of the six months has been 87,296 tons, against 82,598 in the first half of last year, and 98,425 in 1885.

THE City and Guilds of London Institute will have a students' *conversazione* on Friday next, commencing at seven o'clock. Professor Ayrton will open with a lecture on "Church Bells," after which a concert will be given, the programme of which is of a promising character.

CONSUL DUPUIS, of Teneriffe, states that he is constantly receiving inquiries from English merchants for the names of agents for their machines and tools, but that there is scarcely any sale for machinery there. Agricultural machinery is almost unknown, and there are no imports of engines or machine tools.

MESSRS. GEO. ADAMS AND SONS, of the Mars Ironworks, Wolverhampton, have just purchased the almost new plant formerly owned by the Imperial Galvanised Iron Company, Wolverhampton. The plant has been removed to the Mars Ironworks, where it has been erected, and will be used in extending production. The firm report themselves busy.

WE regret to have to announce the death of Commissary-General R. M. Gardiner, which occurred on the 4th inst., at his residence, 53, Comeragh-road, West Kensington, after a short illness. For the past eleven years he held the appointment of managing director to the Cotton Powder Company, to the entire satisfaction of the directors and shareholders.

ONE hundred and eighty-six new companies with limited liability were registered in the month of June, representing a nominal capital of nearly £22,000,000 sterling. The largest is the Mexican Land Mortgage Company, with a capital of £3,000,000; and among the smallest is the "Amalgamated Company of Showmen and Amusement Caterers," with a capital of £2000."

THE announcement of the melancholy death by suicide of Mr. John Turton, of Bolton, assistant inspector of mines under Mr. Joseph Dickinson, will be received with general regret throughout Lancashire. Mr. Turton had been suffering from overstrain, and had gone to Scotland for rest and change, but without beneficial effect, and on Monday committed suicide by cutting his throat.

THE Providence Ironworks, Spon-lane, West Bromwich, which has been standing for some time, has now been purchased by Mr. Albert Wood, of the Globe Ironworks, Walsall, and will be re-started on the manufacture of hoops, bars, and channel iron. Employment will now be found for some of the numerous hands who have been turned adrift by the stoppage of the Bromford Works. It would be well, too, if some of the idle sheet mills in the district were to be set going.

MR. THOMAS ALEXANDER, C.E., has just been appointed to the Professorship of Engineering in Dublin University. About the end of last year Mr. Alexander returned home from Japan, where he held the Professorship of Engineering in the Imperial College of Engineering, Tokio. While in Japan he published, conjointly with his former colleague, Mr. Arthur W. Thomson, B.Sc., a valuable work on "Applied Mechanics," as well as several other papers of importance on technical matters.

THE genius that can spin a cotton or a woollen cop on a bare spindle that will weave from the inside, that is, similar to what is used on a carpet loom and on the Lyall loom, according to Wade's *Fibre and Fabric*, will earn a fortune. This has not been accomplished on fine yarn with a loom running at a high rate of speed. We believe that a cop can be wound by hand that will weave in this way. It requires a rapid vibration while winding on to prevent the yarn from sloughing off in a tangled mass when weaving. With this fact before us, it would seem that some genius ought to be able to produce the motions that will produce the cop wanted.

THE Westinghouse Electric Company is meeting, it is stated, with an enormous demand for their alternating system for central station work. The American *Electrical World* says, the shops employ about 1200 men, and are working a night gang, while the lamp factory is claimed to be the largest in the United States. They have now over forty stations under construction or in operation. Recent contracts have been made in Pittsfield and Springfield, Mass.; Hartford, Conn.; Denver, Colorado Springs and Ouray, Col.; St. Louis, Mo.; Cornwall, Canada; Littleton, N.H.; Portland, Me.; Morristown, N.J.; Staten Island, N.Y.; Galveston, Tex., and Charleston, W. Va.

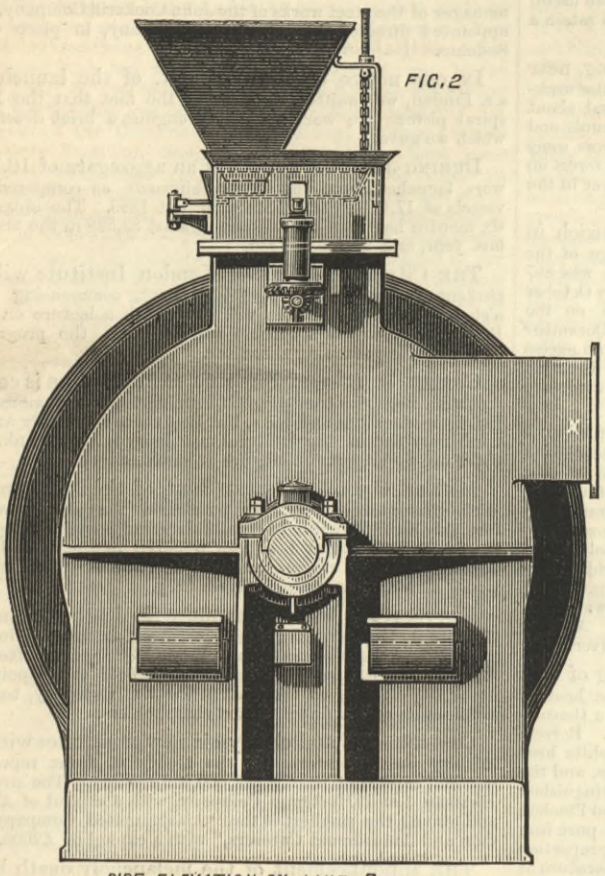
MR. THOS. HAWKSLEY has conferred with the Dundee Water Commissioners, in connection with the proposal to duplicate the Lintrathen main pipe between Shanzie and Pitnappie, and given his opinion in favour of the proposal, and strongly recommended the Commissioners also to continue the second pipe from Shanzie to the reservoir, as this would put 15,000,000 gallons of water at their command, in place of from 10,000,000 gallons to 10,500,000 gallons, and would, besides, completely guard the town from the effects of bursts. The estimated cost of duplication as proposed is £38,000, and the addition recommended by Mr. Hawksley would, it is calculated, amount to about £18,000.

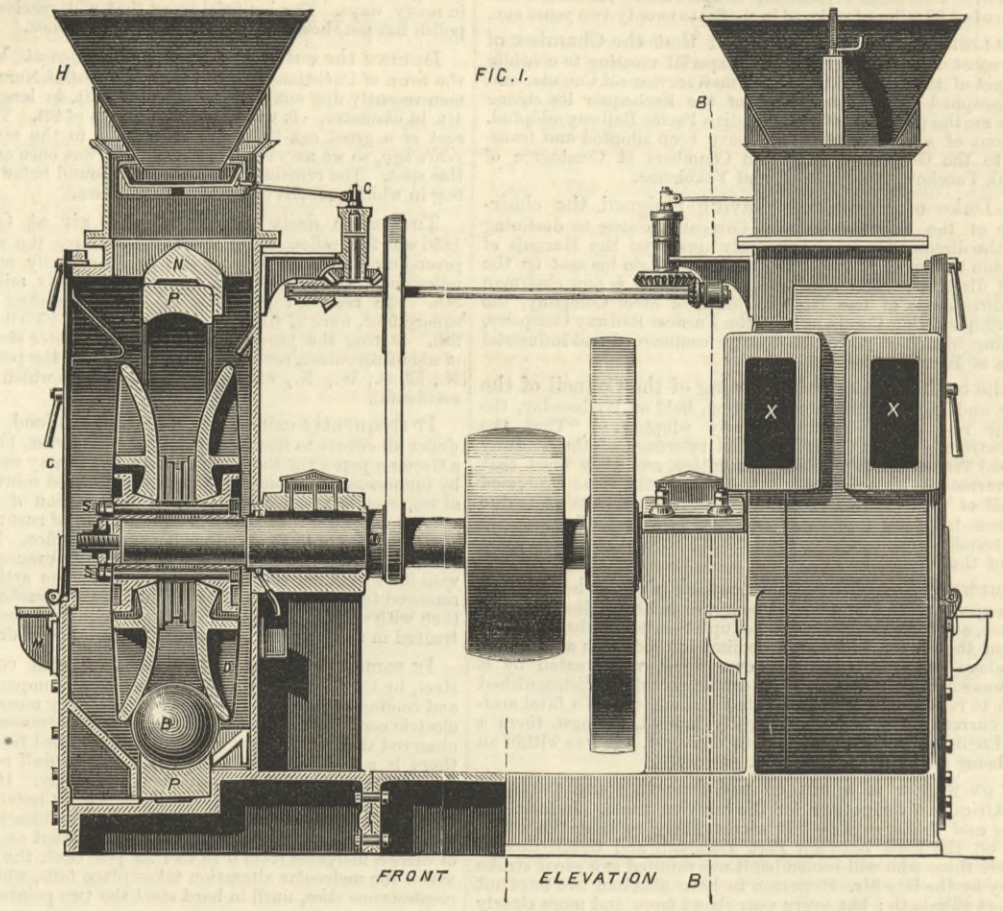
THE next conference of the Associated Iron and Steel Workers of Great Britain is fixed to be held at Sheffield, beginning on Bank Holiday, August 1. Each ironworking district is again to be represented at Sheffield, as at the Manchester conference. It is expected that a return will be made to the conference of over 4000 members. The central offices are to be at Darlington, and efforts will be made to secure early representation of the operatives in Parliament. Mr. E. Trow, of Darlington, is the honorary secretary. The Northern Association, of which Mr. Shaw is president, numbers several thousand members, so that the steel and iron workers are becoming numerically influential. The conference expenses are to be paid by a levy of 6d. each member.

A LEADING feature in the Jubilee illuminations at Lincoln was the exhibition of the electric light on the Rood Tower of the cathedral, the success of which was due to Messrs. Robey and Co. The decision to light the cathedral with this brilliant light was only arrived at on Monday night, the 13th ult., and the work was commenced on the following morning. Thirty-two arc lights were provided, twenty-eight surrounding the parapet, and one surmounting each of the pinnacles. Each light was of 2000-candle power, so that the aggregate was 64,000-candle power, an illumination such as has not before been seen in this county. To supply the requisite motive-power, a Robey-fixed engine, developing 60-horse power, was utilised and attached to a powerful dynamo. We learn that the electric display on the cathedral tower was observed at Boston, Peterborough, and Ely on the south, and Doncaster and York on the North, also far into the Midland counties. It was described by those who saw it a few miles from Lincoln as a square mass of white, glowing flame.

THE GLOBE QUARTZ CRUSHING MILL

THE GLOBE MILL COMPANY, LONDON, ENGINEERS.





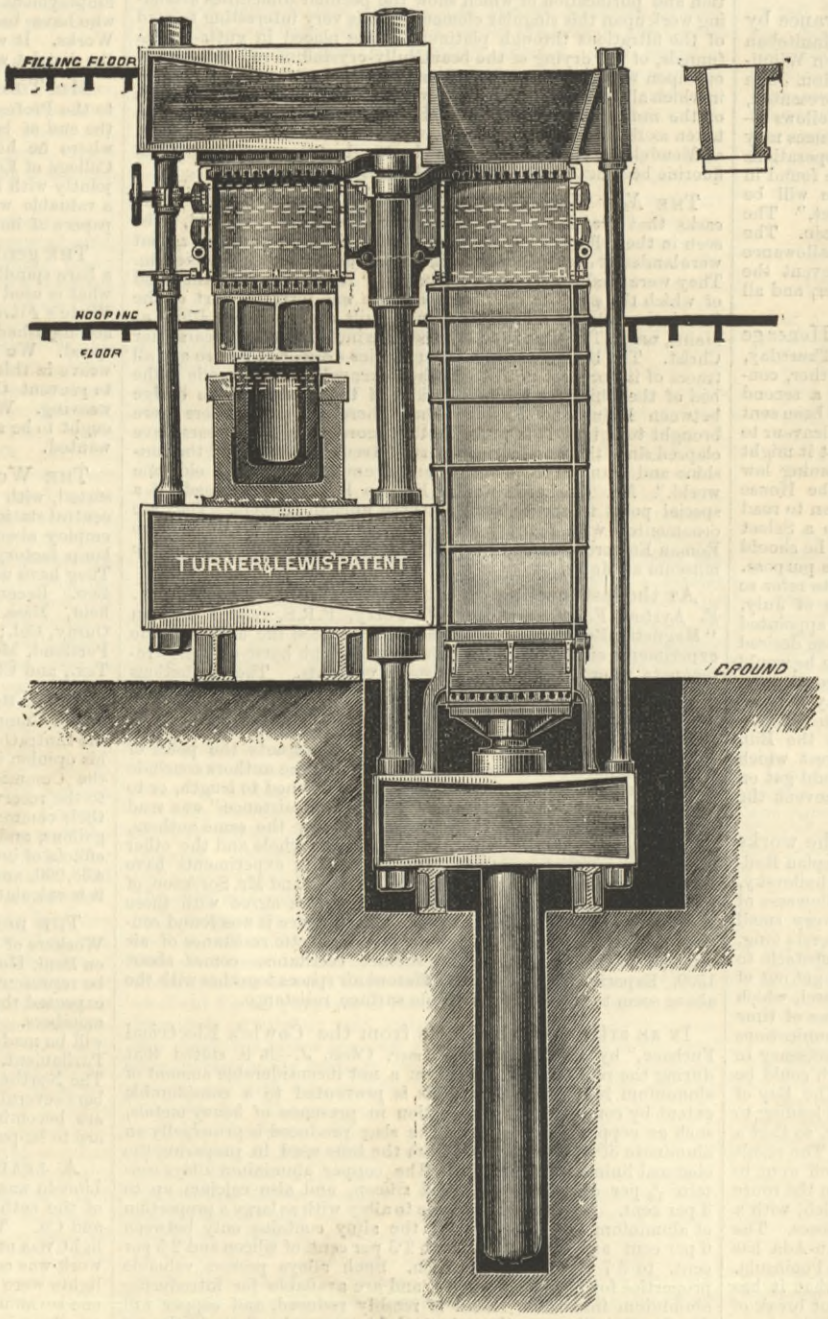
THE GLOBE QUARTZ CRUSHING MILL.

THE mill illustrated by the accompanying engravings is made by the Globe Mill Company, London, for pulverising hard substances, such as quartz, slag, phosphatic rocks. The mill is made under Thompson's patent, and in its earlier form was illustrated and described at length in THE ENGINEER. Since that time various improvements have been made, and extended experience has given the makers valuable information relating to the materials best suited to the ball and the ball path, and to the arrangement of the discs which carry the ball round by frictional grip.

The company has now two mills fixed in its premises at Bermondsey, one for working dry, and the other for working wet. The latter we have seen in operation, pulverising Indian quartz, containing an unworkable quantity of gold, and producing a quartz sand, mixed with a considerable quantity of alluvial discolouring material; and we have also seen it at work pulverising small flints, chiefly rounded and water-worn, and much in the condition of a quantity of material taken from the Greenwich beds. Before passing into the Globe mill, the materials are reduced by a stone breaker, so that the maximum size is that of a walnut. As it leaves the stone breaker, there is necessarily a large quantity of much smaller size; and with friable material, even though it may be hard, there is a good deal that is approaching fineness. This is, of course, always the case with any materials that have to be crushed, especially, perhaps, the Canadian and other phosphatic ores, which are so largely ground for the manufacture of artificial manure.

The mill we illustrate above is a new design, and in some respects differs from that now at work on the materials above-mentioned. At Fig. 1 is shown a pair of mills on one stand, one being shown in end elevation and one in transverse section, and Fig. 2 is a side elevation. This mill is arranged to work dry. The crushing ball B is carried round upon the circular path P by the elastic grip of the curved discs D, the elastic grip being obtained by an elastic cushion between the discs D, and consisting of flat discs of rubber and plate iron. The grip is adjusted by the bolts *s* and the central screw upon the main spindle. The material to be crushed is fed into the hopper, and falls from this to the tray beneath it, which receives a jogging motion from the little crank pin G, driven by bevel gear. From this it falls into the mill, the quantity being adjusted by the inclination given to the tray. Air is admitted at the two entrances M, and the ground materials are carried away from the trunks X X by means of an exhaust fan situated on a depositing chamber to which the mill is connected, the material remaining in the mill until it is sufficiently ground to be carried by the exhaust current.

The mill at work on the materials named differs from that illustrated in that there is a bearing on both sides of the discs D, and that instead of working dry, and carrying the ground materials away by an exhaust air current, the material is carried away by a current of water, which entering the machine at the upper part, passes away through covers at the lower part, which are in part made of brass wire gauze supported by perforated iron plates. The water also enters round the bearings, the primary object being to prevent the grit finding its way into them. The gauze on the mill at work is of what is called 60 meshes to the inch, and is 60 meshes in one direction to about 42 meshes in the other, so that the apertures per square inch are about 2520 per inch. Working on the Indian quartz, the mill pulverised and passed through this gauze at the rate of about 1500 lb. to 1900 lb. per hour. Other gauze has been used with a mesh of 60 by 60, and still finer gauze has also been used for crushing the tailings from stamp mills, some of this with gauze 120 mesh. The flints are much tougher and stronger than the Indian quartz, and the quantity ground was necessarily much less; but although not measured precisely, it was estimated to be at about half the above rates. The mill is driven by two light cotton belts 4in. wide, at about 350 revolutions per minute, the path being 2ft. 6in. diameter. The power required was not taken. It was driven by a rather old 12-horse power nominal portable, which did not appear to be doing more than 10-horse work. At the time of our visit, when the mill was running on the flints, the feed tray was dropped too low and the mill was choked, and hence it became necessary to stop it and clean it out. This operation takes some time, and shows the value of the new arrangement seen above, in which the discs are overhung, and the interior is readily accessible by the outer cover C. The new arrangement recommends itself in many ways, and those interested in the reduction of quartz and other hard materials will be repaid by a visit to the Globe Company's premises.



TURNER'S LIGHT BALING AND FINISHING PRESS.

TURNER'S COMBINED LIGHT BALING AND FINISHING PRESS.

THE system of a light first press, and a special and more powerful finishing press, is very common in India. The press illustrated is made to combine the two, the various operations of each process being independent of the other. A capability of turning out more bales per hour than any system at present in use is claimed for this press. If the whole operation of pressing and finishing the bale is done in one press with one box, much time is lost in waiting for the bale to be lashed and the rams run down before the single box can be filled, but in the press illustrated any of these operations, being independent of the others, may be carried out simultaneously, thus saving much time. It is made as a double press, with one fixed long box, in which the first pressure is given to the bale, and two revolving top boxes, which transfer the lightly pressed bale from the light press to the finisher, where the final pressure is given. In working, the long box is filled through the top of the press, which is made hollow for the purpose, the false top with its lashing plate is then turned into its place, covering the aperture in the press top, and the ram being rapidly run up level with the top revolving box, the material is partly pressed, the bottom lashing plate being held in position by four catches, or the bale may be secured by being loosely lashed. The top box, with the bale, is then revolved until it is under the finishing press, which has a much larger and more powerful cylinder, where the bale is finally pressed to its complete density; and the box doors being now opened, the bale is banded and turned out finished. During these operations the light press is again being filled, and the material in the box pressed, and by the time the first bale is turned out of the finisher, another lightly pressed bale is ready for the final pressure. The fixed box is of cast iron, and has no working parts except the bottom door but the top revolving boxes are built up entirely of wrought iron and steel plates and bars, and all the working parts are of steel. These boxes revolve on steel balls, which run in a steel-faced race, attached to the centre column of the press. The cylinders are of cast steel, with steel glands and cold blast cast iron turned and polished rams. With proper working it is stated that this press should make thirty-five bales of cotton of 400 lb. each, per hour, and as the bales are held in the box under the final pressure they assume a very nearly square form, and the freight measurement is of course proportional to the density obtained, and is, we are informed, superior to that from presses on other systems. The engraving does not show the combined press in detail, but its detail arrangement will be readily understood.

PROSSER'S TRAM RAIL CLEANER.

Fig 1

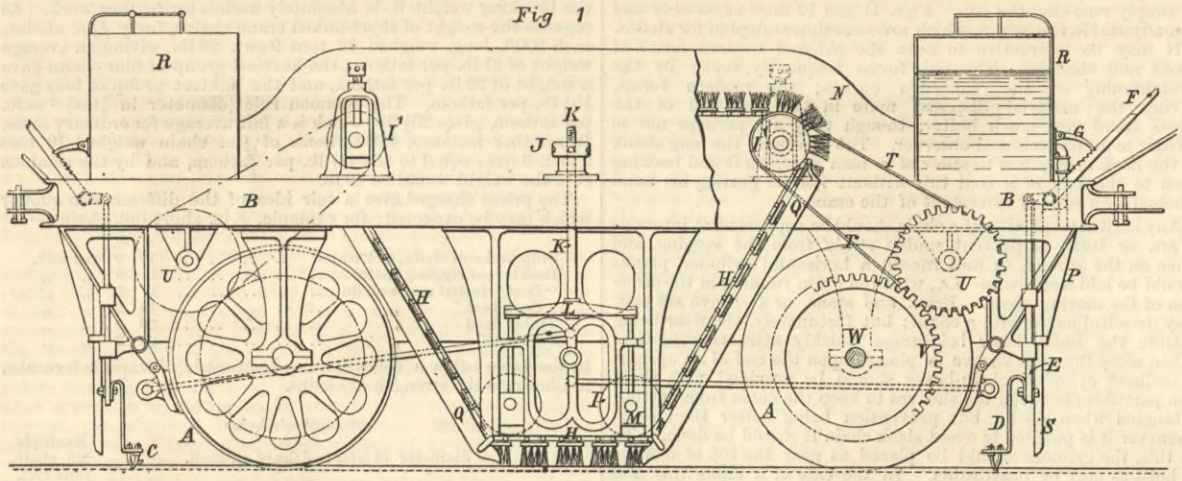


Fig 2

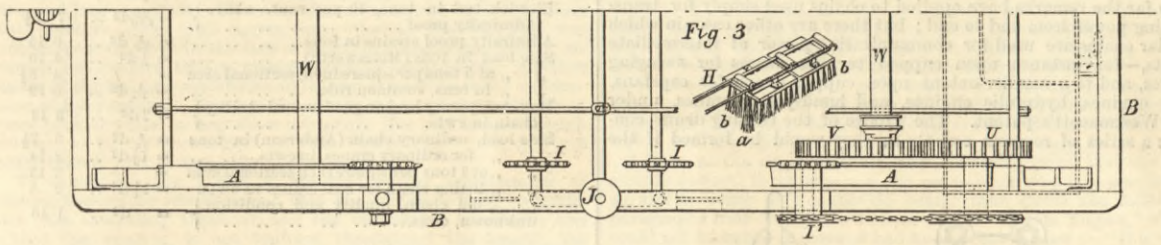
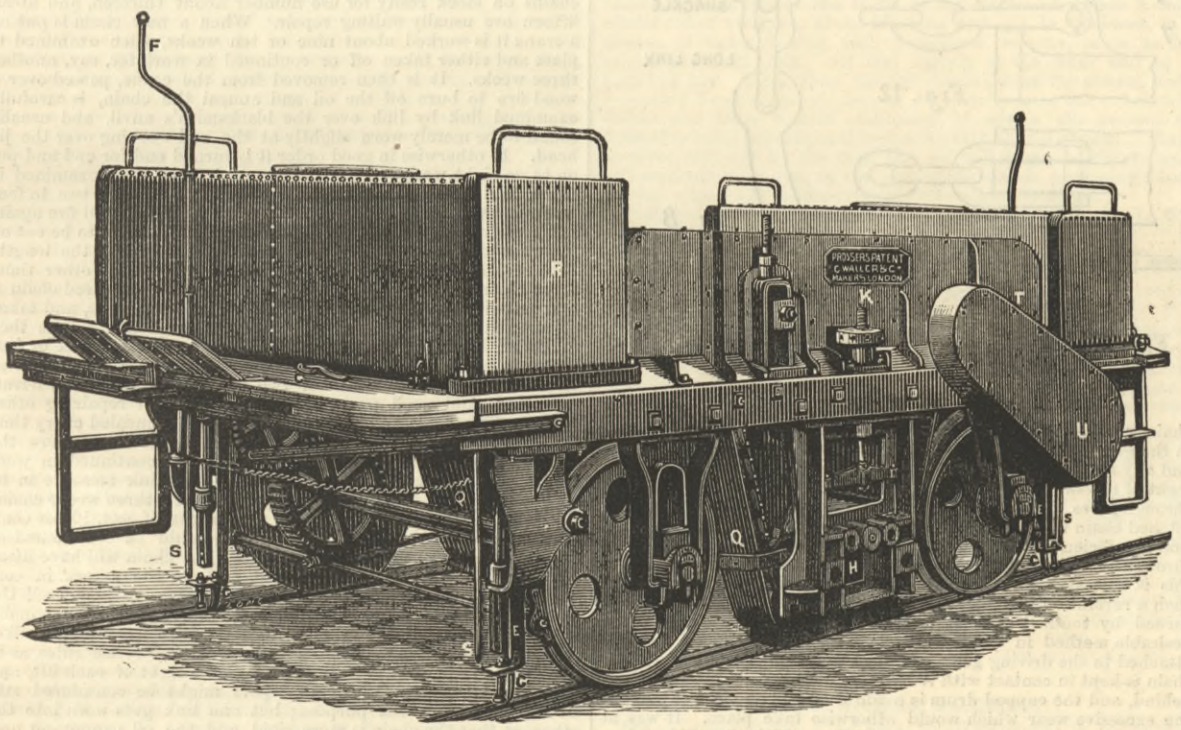


Fig 3

PROSSER'S TRAM RAIL CLEARER.

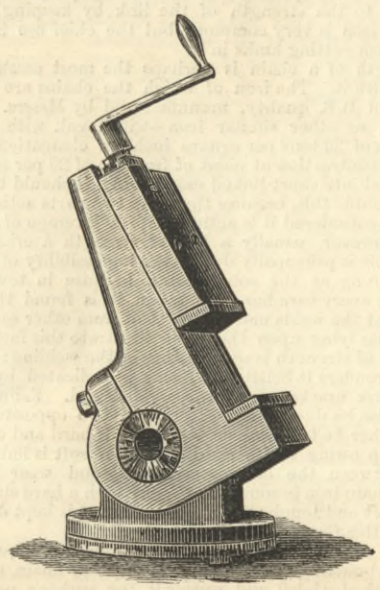
DURING the last few years a number of inventions have been tried for clearing dirt from the grooves of tram rails. At the present time the universal practice is to employ men, who scoop the dirt from the rails and deposit it into carts. Most of the appliances hitherto introduced have been connected to the tram car, and they threw the refuse on one side, and this so ineffectually that no tramway company has been able to adopt them. Mr. Jno. Prosser, of Bury-street, London, has for some time been engaged in making an efficient machine which should combine all the advantages of manual labour with increased speed and economy. An experimental machine has been run over 200 miles with such success that the North Metropolitan Tramway Company has had one built to its order. The tram rail clearer as illustrated fulfils other duties than that of clearing the tram rails. It salts, sands, or gravels the permanent way, and waters the lines, as desired. Being automatic, it only requires a driver. It clears the lines and loads up all the refuse it displaces at the rate of eight miles per hour, leaving no deposit behind, as at present. In the perspective H shows the position of the mud carriers, which revolve on an upper drum and carry the mud up the shoot Q, depositing it into the centre of the vehicle. R is the gear for regulating the carriers; by this they can be made to cut deeper or shallower as may be required. U is the cover of the driving gear, R R shows the water or brine tanks, S S the outlet for same. The first tank can be used to lay the dust in dry weather, and the second to water the lines when the machine has cleared them. C C shows two steel ploughs, which can be regulated by a lever under the control of the driver. They are intended only to be used for snow, ice, or hard mud, which they displace and assist the carriers to remove. E shows the spring of the ploughs. The whole gearing can be thrown out of motion by a clutch when the cart is loaded, and it then travels like an ordinary trolley. Referring to the engravings Figs. 1, 2, and 3, C C are the scrapers attached to springy plates D D, so that they can yield when striking against, say, a stone firmly fixed in the groove of the rail; these plates are attached to rods E E, and can be lifted by foot levers F F when not required for use, the levers being held by the pawls G for that purpose. H H is a series of brushes arranged in an endless manner round four sprocket or chain wheels I I I^1 I^1, two of which I I are near the rails, and capable of being depressed into contact by means of the capstan head J working upon the screw arm K, the crosshead L of which has the rollers I I by blocks M M attached thereto. The other rollers I^1 I^1 are within a casing N, the ends of which form part of a receptacle P, into which the dirt when lifted by the brushes falls after travelling up the incline plates Q Q, from which receptacle the dirt can be permitted to fall by moving sliding doors. R R are water tanks, one at each end of the vehicle, and S S are pipes leading therefrom for furnishing water, or it may be brine in frosty weather, for moistening the dirt, to facilitate a more easy action of the brushes. The pipes S S by having a branch connected to them may be used for watering the track on which the horses travel. Motion is given to the brushes by means of a strap and the spur wheels V V fitted loosely on the axles W W, but capable of being put in motion therewith by the clutch and lever X. This spur gearing is arranged at opposite corners, as seen more particularly at Fig. 2, so that motion is given to the brushes from the direction of travel, the driver having the appliances at that end under his command.



PROSSER'S TRAM RAIL CLEANER.—PERSPECTIVE VIEW.

COSGROVE'S UNIVERSAL VICE CHUCK.

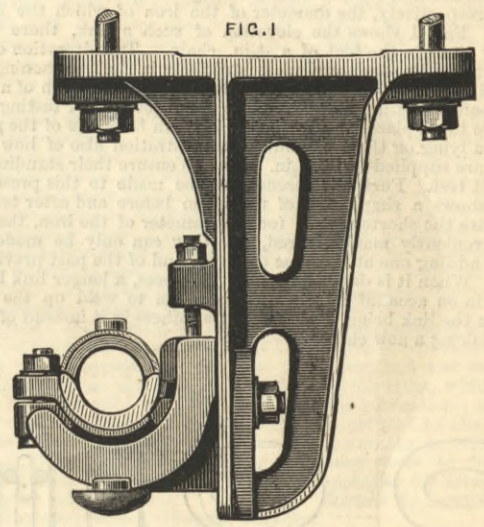
THE especial advantage claimed for this tool, which has been recently introduced by Messrs. Pedrick and Ayer, of Philadelphia,

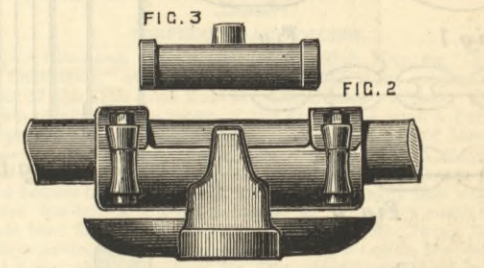


is its great range of positions. It is adapted to swing from a horizontal to a vertical position, or to stand at any angle between the two, the graduated plate shown at the very bottom of the engraving serving for setting it at any desired angle horizontally, while it can be set at any angle in a vertical plane by means of the trunnion graduated arc, being clamped after setting by the two nuts, one of which is shown in the cut. This construction, it is not unreasonably claimed, greatly facilitates the milling or planing of pieces at an angle.

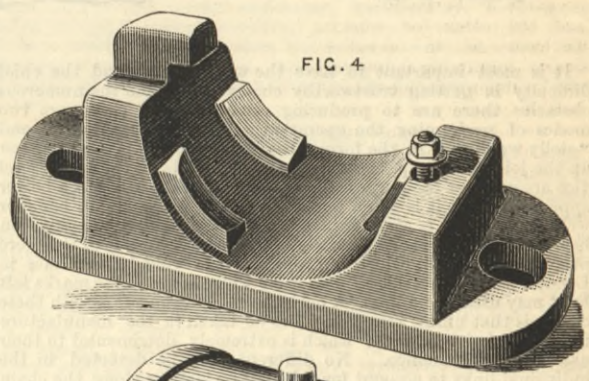
FORDSMITH'S SHAFTING BEARINGS.

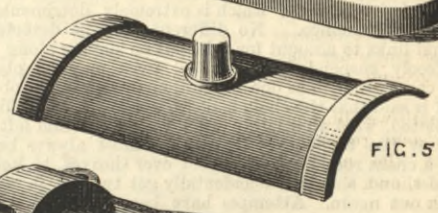
THE accompanying engravings illustrate bearings for shafting both for pedestal and hanger brackets or supports. From these it will be seen that the bearing is free to move to the position required by the shafting, and that this is obtained without costly fitting and with easy adjustment. The bearing has a spherical bottom resting on three small surfaces, which cause the bearing to rest evenly, and allows it to adjust itself freely in all directions to the shaft. In our engravings Fig. 1 is a side

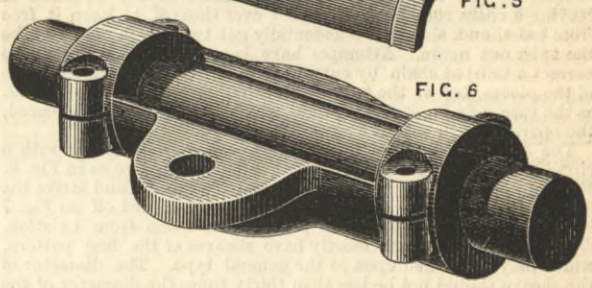




view of a hanger bracket, Fig. 2 a front view of its lower part with the bearing and hanging oil tray, and Fig. 3 is the central cover. In Figs. 4, 5, and 6, are perspective views of the several parts of the bearing. Fig. 6 shows the bearing with the spherical bottom, and as it is cast, except that a spindle is shown in it. In casting this the small slots separating the small caps from the lower part of the bearing are cast in with a piece left at each slot, and these are afterwards split open. There is







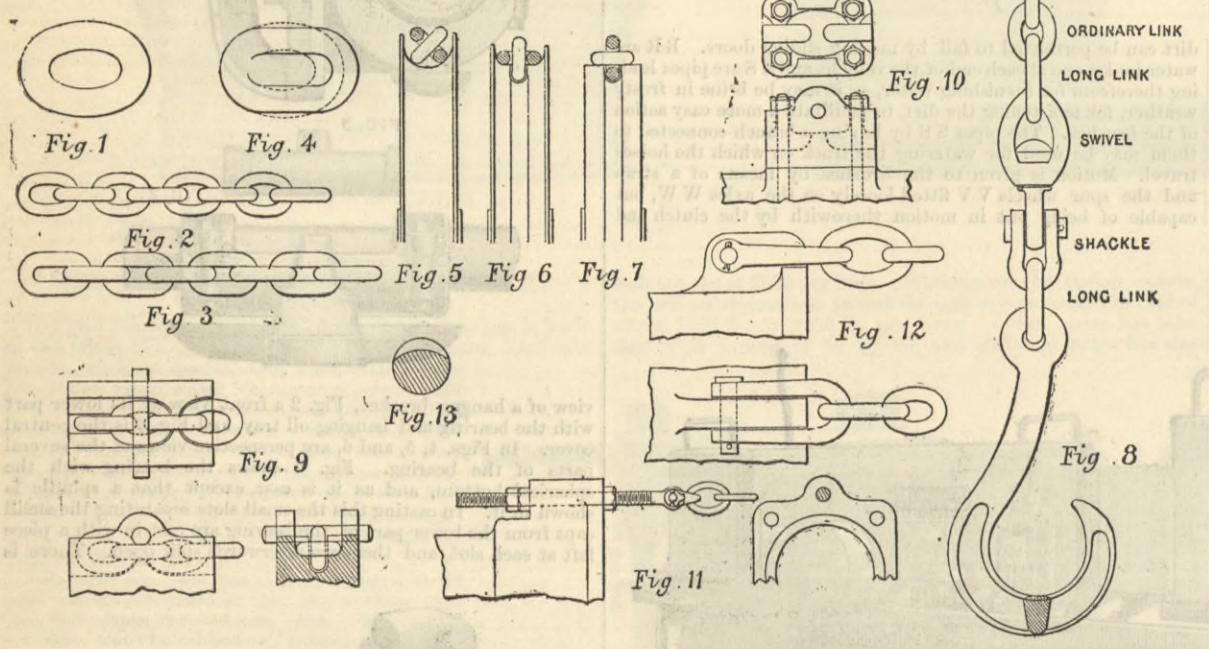
only one holding-down bolt, and this has no tendency to draw the bearing from any position that the shaft gives it, one side of the bearing being held by the lip—see Fig. 4—cast upon the pedestal of either form. The upper part of the bearing is held by four small bolts and nuts, and the greater part of the cover, Fig. 5, is a light casting only placed over the journal without fastenings as a protection from dirt. The bearings and hangers are made by Mr. Herbert Fordsmith, and are very simple in design.

THE SCHOOL OF ELECTRICAL ENGINEERING.—A very successful *conversazione* was given by Mr. W. Lant Carpenter, F.C.S., and Mr. Leon Drugman in the rooms of the School of Electrical Engineering on the 1st instant. Large numbers of leaders in the electrical and scientific world were present, and were much interested, and many much surprised at the comprehensive plant and apparatus in use in the school for the thorough teaching of the theory and applied theory in electric lighting, telegraphy, and cable work, and including several dynamo machines, steam engine, gas engine, arc and other lamps, all kinds of measuring, transmitting, and recording apparatus, an artificial ocean cable and its costly connected apparatus and other telegraphic specialities.

THE USE AND CARE OF CHAINS FOR LIFTING AND HAULING.[1]

By HENRY ADAMS, M. Inst. C.E.

CHAINS for lifting and hauling may be divided into two classes—those with oval welded links and those composed of flat plates or bars connected by pins; the former are generally known as "short linked crane chains," and the latter as "pitched chains." In "common" oval link chains the links are made long to reduce the cost; fewer of them go to the fathom or ton, and therefore the labour upon them is cheaper for a given quantity of length or weight. For lifting or hauling purposes these links would require an enlarged sheave or drum to avoid risk of fracture by bending on the curve. But they have a more serious defect. The sides of the links are straight, and when a jerk occurs upon such a chain sustaining a load, there is considerable rigidity, so that the load is restricted in its movement, and hence the tensile stress is greatly increased. A short link chain, on the other hand, has the links well rounded, so that when the load surges each one acts as a spring and yields a trifle. The proportions adopted in the best practice are, for the extreme length and breadth, $4\frac{3}{4}$ and $3\frac{1}{3}$ times, respectively, the diameter of the iron of which the link is made. Fig. 1 shows the elevation of such a link, there being exactly eight to the foot of a $\frac{9}{16}$in. chain. The alteration of the shape in yielding is shown most strikingly in the lengthening produced by a breaking strain. Fig. 2 shows a foot length of a $\frac{13}{16}$in. chain before testing, and Fig. 3 the same piece after testing until fracture takes place. This example is taken from one of the pieces of chain lying on the table, and is an illustration also of how $\frac{9}{16}$in. chains are supplied—viz., $\frac{1}{32}$in. larger, to ensure their standing the contract test. Further reference will be made to this presently. Fig. 4 shows a single link of the chain before and after testing. These are the shortest links, for the diameter of the iron, that can be conveniently manufactured, and they can only be made this size by adding one at the time on to the end of the part previously made. When it is desired to join two pieces, a longer link has to be put in on account of the want of room to weld up the end, because the link being welded has two others in it instead of one, as in making a new chain.



It is most important to have the welds sound, and the chief difficulty in getting trustworthy chains arises from the numerous obstacles there are to producing sound welds. There are two modes of performing the operation, "hammer welding" and "dolly welding;" in the former the hammer alone is used to close up the joint and keep the shape accurate, while in the latter steel dies are used for the purpose. In dolly welding the link has a better appearance, but it is often imperfect in the interior. In hammer welding the joint is rougher in appearance, although the junction between the surfaces is generally more complete owing to the more perfect hammering which it receives. The weld in this case in London work is dressed off with a file while hot, and the marks left by it may usually be seen. A curious fact in connection with these chains is that unless very great care be taken in the manufacture they get a twist in them which is extremely detrimental to their use and maintenance. No difference can be detected in the individual links to account for this, but on looking along the chain when freely suspended, a gradual twist may be observed, in extreme cases as much as one revolution in 20ft. To obviate this result it is said that the chain makers, whose chains are liable to be thus afflicted, weld alternately with their right and left hand, to counteract the tendency. Great care must always be taken in reeving a chain round cylinders and over sheaves, to keep it free from twist, and, should it accidentally get twisted in use, to take the twist out again. Attempts have been made by workmen to correct a twisted chain by cutting it in halves and reversing one of the pieces, but as the twist remains either right or left-handed, as the case may be, in both pieces, whichever way they are placed, the operation can convey no possible benefit.

The sheaves for guiding the chains are formed either with a circular groove as in Fig. 5, or with a shaped groove as in Fig. 6. For a jib head, where the crane hook may run up and strike the sheave, the shaped groove with the outer rim turned off as Fig. 7 is found to stand best and to prevent the chain from twisting. Cylinder and ram ends mostly have sheaves of the first pattern, which may be looked upon as the general type. The diameter of the sheave should not be less than thirty times the diameter of the chain iron. The loose end of a chain should have a strong and compact swivel, so that goods lifted by it if turned round should not twist the chain. This may either be made as part of the hook or in a separate piece. In coal cranes, where we may look for the best practice because of the nature of the work and the number of lives at stake, the arrangement shown in Fig. 8 is adopted when the jib head is high enough to allow the requisite length.

For ordinary crane chains, jigger hoists, and loose leads, it is usual to have an oval counterweight upon the end of the chain to overhaul it when no load is hanging therefrom; but in coal cranes this is not admissible, and hence the further advantage of the accessories to the hook by reason of their weight. A small cylinder and piston, something like a Duckham weighing machine, but working with an air cushion, was invented by Meredith Jones, and modified by the author, for taking the place of the counterweight on cranes, to prevent the snapping of chains by sudden jerks. This worked well, but being applied to a coal crane was objected to by the "coalies," and had to be discarded; for ordinary cranes or hoists nothing could be better. A method applicable to all chains in hydraulic machinery would be to interpose a draw-bar with a strong spiral spring or other elastic medium between the fast end of the chain and the lug or bracket on the cylinder to which it is usually fixed. This lug is generally made as in Fig. 9, cast solid on the cylinder. A better plan, which is sometimes adopted, is to make this a separate piece bolted on as in Fig. 10, because in driving the cross pin to hold the chain the holes are frequently burst, and then an awkward patch has to be made, instead of simply renewing the cup. Figs. 11 and 12 show adjustable and non-adjustable fastenings, which are sometimes adopted for chains.

It may be instructive to note the old and modern forms of hooks and shackles. The old forms frequently broke by the straightening of the excessive curves; the modern forms, having the material disposed more in the direction of the stress, stand very much better, though they are perhaps not so artistic to a non-technical observer. The reason of the long shank to the hook in Fig. 8 is to allow of a man grasping it and hooking it on to the bale of a coal tub without risk of getting his hand pinched by a sudden movement of the crane.

Any horizontal portion of a chain should be supported at intervals of 8ft. or 10ft., to prevent undue strain from the sagging, and when on the ground, as underneath a horizontal cylinder, planks should be laid lengthwise—*i.e.*, with the grain running in the direction of the moving chain. Brick and stone, or a sheave set fast, play dreadful havoc with a chain; but fortunately, the wear being outside the links, their brightness quickly attracts attention. When more than one sheave is placed upon the end of an upright or inclined cylinder, chain-boxes should be provided, with sheet iron partitions between the sheaves to keep the chain from getting entangled when slack; but prevention being better than cure, whenever it is possible to avoid slack chain it should be done. To do this, the cylinder should be placed as near the top of a crane or hoist as may be practicable. In the case of a crane this also prevents the unloaded chain from running up to the jib head and jambing fast if it should be accidentally let go.

So far the remarks have applied to chains used simply for transmitting power from end to end; but there are other cases in which similar chains are used for communicating power at intermediate points,—for instance, upon cupped turning drums for swinging cranes, and to a smaller extent upon cupped drums for capstans, gate engines, hydraulic engines, and hand-power cranes, under Mr. Westmacott's patent. The groove of the turning drums contains a series of recesses exactly as they would be formed if the chain were pressed into a mass of putty or soft gutta-percha laid in the groove. These recesses are cast with the drum or sheave, and any movement of the chain therefore compels a similar movement of the sheave. This arrangement enables the crane to turn through more than one revolution if required; in large cranes a pitched chain is used in the same way. When less than a revolution is sufficient an ordinary plain groove is used, with a cross-pin through it to hold the chain at one point, and a modification of this is sometimes used with a spiral groove, so as to get more than a revolution without using a cupped drum. Other cranes are turned by toothed gearing instead of a chain, but this is not a desirable method in quick working. When the cupped drum is attached to the driving gear, as in the patent just referred to, the chain is kept in contact with it by means of a small grooved roller behind, and the cupped drum is made of chilled cast iron to prevent the excessive wear which would otherwise take place. It was at one time thought that this arrangement would have a wide adoption, but in practice it was found that, with a chain proportioned to the load in the usual manner, the stretching and alteration of pitch by wear were such as to allow the links to ride upon the edges of the cups and get pieces nipped out. By observation upon chains in use, the lengthening after a short time reaches between 3 and 4 per cent., or rather less than $\frac{1}{16}$in. between each pair of surfaces in contact. This is probably due to the rubbing off of the scale upon the iron, and partly also to wearing down to a fuller bearing, rather than to an actual stretching of the material, because it must be remembered that when new the bearing of the two rounded surfaces is not much more than a point. Stud link chains are only used for ships' cables and mooring purposes. The stud adds a little to the strength of the link by keeping it in shape, because the iron is very common; but the chief use is to prevent the chain from getting kinks in it.

The strength of a chain is perhaps the most essential matter connected with it. The iron of which the chains are made—say, S Crown C of B.B. quality, manufactured by Messrs. Bradley, of Stourbridge, or other similar iron—will break with an average tensile stress of 26 tons per square inch, an elongation of 15 per cent., and a contraction at point of fracture of 20 per cent. When manufactured into short-linked crane chain, it should theoretically withstand double this, because there are two parts acting, or if one side only be considered it is acting with a leverage of two to one. There is, however, usually a loss of strength averaging 25 per cent., but this is principally due to the impossibility of making the welds as strong as the solid metal, because in testing sample pieces, when every care has been taken, it is found that they fail by opening at the welds more often than from other causes. Some of the samples lying upon the table illustrate this fact. Another cause of loss of strength is overheating in the welding; the burning of the iron renders it brittle, and this is indicated by a series of fine transverse cracks across the welded end. Failure in actual work may also be due to the material in two opposite ways—the iron may either be too hard or too soft. If hard and crystalline it is apt to snap owing to its rigidity, and if soft is liable to cut by abrasion between the bearing surfaces, and wear away very quickly. Chain iron is sometimes found with a hard side, although otherwise soft and tough; when the hard part is kept on the inside of the links this forms the best possible chain.

In taking contracts for crane chain, agents are quite ready to guarantee a breaking test of 11 tons on a $\frac{9}{16}$ chain, and produce samples marked 11-1-0 and upwards, the author's practice is to stipulate for 10 tons only, and, notwithstanding the samples, has had to reject chains from various makers because they failed at 9 tons. For ordinary testing, when the whole chain has to be dealt with, each 15 fathoms of the length is treated separately, but when it is desired to ascertain the ultimate strength, a piece only 4ft. long is cut off for the purpose, as when strained to more than half the breaking weight it is absolutely useless for further work. As regards the weight of short-linked crane chains, forty $\frac{9}{16}$in. chains, each 200ft. long, weighed 12 tons 9 cwt. 23 lb., giving an average weight of 21 lb. per fathom; the heaviest group of four chains gave a weight of 22 lb. per fathom, and the lightest group of four gave $19\frac{1}{2}$ lb. per fathom. The common rule (diameter in $\frac{1}{8}$ths) $^2 =$ lb. per fathom, gives $20\frac{1}{4}$ lb., which is a fair average for ordinary cases. In another instance, 480 fathoms of $\frac{7}{8}$in. chain weighed 10 tons 9 cwt. 3 qrs., equal to 48·9417 lb. per fathom, and by the common rule the weight would be 49 lb.

The prices charged give a fair idea of the difference in quality which may be expected; for example, $\frac{9}{16}$in. short link chain:—

	s.	d.	
Ship and coil chain, not tested	10	9	per cwt.
Best tested rigging chain..	11	9	,, ,,
"Best" tested crane chain	17	3	,, ,,
"Best best" ,, ...	19	3	,, ,,
Treble best ,, ...	20	9	,, ,,
S crown C ,, ...	24	3	,, ,,

In the table below a collection has been made of various formulæ, to illustrate the strength of chains.

Strength of Chains

d = diameter of iron in $\frac{1}{8}$ths of an inch.		Example $\frac{3}{4}$in. chain. tons cwt.
B.W. in tons, B.B. short link crane chain ..	$= \frac{1}{2}\,d^2$ ..	18 0
,, ,, ordinary chain	$= \frac{7}{8}\,d^2$ ..	14 8
,, ,, ,, (Anderson)	$= \frac{9}{8}\,d^2$ ..	13 10
Elswick test in tons, 10 per cent. above Admiralty proof	$= \frac{13}{16}d^2$ ..	7 8½
Admiralty proof strains in tons..	$= \frac{9}{16}\,d^2$ ..	6 15
Safe load in tons (Molesworth)..	$= \frac{1}{4}\,d^2$ ..	4 10
,, ,, at 5 tons per square inch, sectional area	=	4 8½
,, ,, in tons, common rule	$= \frac{1}{16}\,d^2$ ..	3 12
Max. temporary load on good annealed sling chain in cwts.	$= 2\,d^2$ ..	3 12
Safe load, ordinary chain (Anderson) in tons	$= \frac{3}{32}\,d^2$ ..	3 7½
,, ,, for ordinary cranes, in cwts.	$= 1\frac{1}{2}\,d^2$ ..	2 14
,, ,, at 3 tons per square inch sectional area	=	2 13
,, ,, lifting chain for coal cranes in cwts.	$= 1\frac{1}{4}\,d^2$ ..	2 5
,, ,, old chain, quality and condition unknown, cwts...	$= \quad d^2$ ..	1 16

With regard to the maintenance of chains, the author has been responsible for the use of about 7000 fathoms of $\frac{9}{16}$in. crane chain and a smaller quantity of other sizes during the last ten years, and will therefore confine his description to the methods which have been proved by experience to be the most suitable for securing a long life and efficiency. These chains, chiefly obtained from Messrs. Moser and Sons, Southwark, are used upon twenty-one cranes belonging to Messrs. Wm. Cory and Son, and have in the time named lifted upwards of 15,000,000 tons of coal from ships' holds and delivered it into trucks or barges. About twenty new chains, 200ft. long, are required each year, the new and repaired chains on stock ready for use number about thirteen, and about fifteen are usually waiting repair. When a new chain is put on a crane it is worked about nine or ten weeks, then examined in place and either taken off or continued in work for, say, another three weeks. It is then removed from the crane, passed over a wood fire to burn off the oil and anneal the chain, is carefully examined link by link over the blacksmith's anvil, and usually found to be merely worn slightly at the end working over the jib head. If otherwise in good order it is turned end for end and put on to go eight weeks, at the end of which time it is examined in place, and either taken off or continued in use for two to four weeks longer. It is then taken off, put through a wood fire again, and closely examined; about 44ft. has probably then to be cut off the outer end, and another piece added to make up the length. Five chains will sometimes cut up into four, and at other times three chains will be required to make two. The repaired chain is now put on to go six weeks, is then examined in place, and taken off or continued in work two or three weeks longer. It is then taken off, burnt, and examined, and put together in three or four pieces to go four weeks, then examined in place, and either taken off or allowed to remain one or two weeks, then taken off, burnt, examined, and good parts, if any, cut out for repairing other chains. The hook and large link, &c., are annealed every time the chain comes off. A tin tally or label is put on to show the estimated period the repaired chain may be continued in work before the next examination. If the worst link measure in its smallest part $\frac{1}{2}$in. full, it would only be called a three weeks chain; $\frac{1}{2}$in. bare, two weeks; and $\frac{7}{16}$in., or a reduction of, say, 10 per cent. on the original substance—see Fig. 13—would be condemned as worn out. Before this stage is reached the chain will have lifted from 50,000 to 100,000 tons of coal, and on the cranes in constant work will last from six to nine months. Although all the chains are made from iron of the same brand, and are nominally of uniform quality, they vary a little, and do not all wear alike, and hence it is impossible to lay down more precise rules as to their care. About 21 cwt. is the average weight of each lift, and links worn to $\frac{7}{8}$ in the smallest part might be considered still strong enough for the purpose; but one link gets worn into the other, so that the chain is more rigid, and the oil cannot get properly into the bearing surfaces, and a slight twist would be liable to burst the link. The best part of a repaired chain is always put over the jib head, because if a worn link at the back end should give way, the time the chain takes to run off the cylinder would give the men more time to escape from beneath the falling load, and the greatest wear taking place here, the chain is more equalised throughout its length.

The lubrication of a chain is of the utmost importance; as an instance of the rapid wear when insufficiently oiled, may be mentioned a $\frac{1}{2}$in. chain from one of the gas works in London, which broke through after lifting about 3400 tons, or making, say, 6800 lifts, or only a tenth part of what it should have done. A piece of this chain is exhibited, and is particularly interesting from the fact that one of the links is so nearly broken through that at the very next lift it must have failed and dropped the load.

The chains of hydraulic machinery should be oiled with a brush say once a week, or oftener if the machines are worked much; they should if possible be slacked back to get the oil well between the links. To oil a chain with an oil can is an expensive and inefficient mode, the brush assists in cleaning the chain and allows the condition to be seen. The oiler should always be on the look-out for worn links or opening welds. The oil used may be the drippings from an engine or machine shop allowed to settle and carefully filtered off. If the oil should cake upon the chain or clog it up so much that its state cannot be seen clearly, it is unsuitable for the purpose. Several varieties of oil have been tried, the most economical and efficient which has been found is that manufactured by the Standard Lubricating Oils Company, and supplied at 2s. 6d. per gallon per ton. It goes further than ordinary oils, and does not cake or harden upon exposure to the air, at the same time it has sufficient body to prevent the cutting of the chain between the links. It is also used for steam engines and machinery of all kinds in summer and winter, and is therefore as good an all-round lubricant as can be wished for. A new chain, or one which has been annealed, should be well oiled with the brush upon a clean floor, and never upon earth or gravel, before it is placed upon the machine, so that the oil may be worked well in between the links, but this is often objected to by the men on account of the mess in afterwards getting it into place. The oil mentioned above works in between the links better than some varieties owing to the mineral oil contained in it, and this perhaps helps to make up its efficiency.

In hotels, warehouses, and large offices much damage is done by the servants sweeping the dust off each floor into the hoistway; the dust cuts the chains and all rubbing surfaces like emery, and

[1] A paper read before the Civil and Mechanical Engineers' Society.

the practice is most reprehensible. Coal dust is not very detrimental to chains, but coke dust is decidedly bad.

Sling and fall chains used in the erection of machinery and buildings are always used dry for various reasons. They should be put through a wood fire and annealed after every large contract, or say every two years, and carefully examined by a skilled man before being taken into use again.

The author has no records of experiments on steel crane chains. "Box," "Strength of Materials," p. 69, gives the result of some experiments at Woolwich Dockyard on stud-linked cable chain of steel, where it appears to be less reliable than iron on account of its loss of strength at the weld. While the bar of steel is 86 per cent. stronger than the iron, the steel chain is shown to be only 4 per cent. stronger. Possibly, with the very mild steel now made, and increased practice in welding steel chains, we might now arrive at a superior article; and the author will be glad to hear if any members have had experience of steel for this purpose.

"Box" also quotes experiments at Woolwich Dockyard on the comparative strength of crane chains when annealed. Ten ¾in. chains and ten unannealed were tested to breaking weight, and showed on the average a loss of 7 per cent. by annealing. It is presumed that they were new and in similar condition, except for the annealing; but it would not be correct to assume from this that annealing is detrimental. In the ordinary way the chain before annealing is not new, and is supposed to have sustained some alteration in its molecular structure by vibration or strain through use, although not perceptibly worn. As a remarkable instance of this change of structure, a piece of wrought iron lying on the table may be specially pointed out. It formed part of a press lever, and was in use for fifty years before it broke. It was not annealed during that time, and it will be seen that the fibrous character is entirely lost, the whole substance consisting of very fine and large crystals. There is, of course, always a doubt, when the fracture gives this appearance, whether the material was originally good; but in the face of so much evidence as there is, we cannot but believe that a change actually takes place. Another cause of the fracture sometimes appearing crystalline is the suddenness of the rupture. Many of the specimens upon the table which were broken while in use show a fracture like cast iron, although known to be of Crown S.C. or B.B. Staffordshire iron, and not more than a year or two old.

To summarise the points of economy in the maintenance of chains, the author would repeat that the testing should be moderate, the annealing frequent, and the lubrication thorough; and where the wearing is not uniform throughout the length, the chains should be cut and pieced when partially worn, so that when finally discarded every link shall have done its full share of work without overstepping the limits of perfect safety.

LETTERS TO THE EDITOR.

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

NEWTON'S THIRD LAW OF MOTION.

SIR,—The attention of professors and engineers has been called repeatedly to the anomaly in Newton's third law of motion, but seemingly to no purpose, for it remains, as it has ever been, obscure. This proposition, viewed in the light thrown by Professor Tait, viz., of conservation of energy, is acceptable, but it may be questioned whether Newton viewed it in the same light, for no proof of this most important of physical laws was forthcoming until quite recently.

The third law of motion, whether true or not, has been accepted, not only because of its originator, but also for the apparent physical confirmation of its import. The *agentis actio scholium* must be considered independently, for if bearing evidence of the practical truth of the third law, it does not help to its comprehension.

It is my purpose to demonstrate the flaw existing in Newton's third law, for it is not strictly true in the sense conveyed to us by his words: "*Actioni contrariam semper et æqualem esse reactionem.*" This proposition is true only in a broad sense, for action and reaction are not equal at every instant of time. In the course of my demonstration I shall express myself in terms now admitted correct, but which are, I believe, obsolete in the present state of science.

The reason why the third law of motion has lain so long without a possible explanation exists simply in the manner of viewing the transfer of energy from the acting to the reacting body. It is admitted without controversy that efforts act continuously, but nothing is more erroneous, for in admitting this we must suppose absolute contact between the particles of a body, which is inadmissible.

Professor Sir William Thomson, in his address as president of the British Association at Montreal, said—"It is scarcely possible to help anticipating in idea the arrival at a complete theory of matter in which all its properties will be seen to be mere attributes of motion." Without wishing to anticipate the complete theory of matter, I believe that I can demonstrate that the transfer of energy takes place, from one body to another, in a continual flow of pendulum motions or pulsations of the particles constituting the acting and receiving bodies, and as a consequence that the energy of a system consists of the motions of the particles of that system. Hence the following proposition:—"The transfer of energy, though continual, does not take place continuously, or an apparently continuous effort acts periodically." I pass now to demonstrate this proposition. Take, for instance, a thin wire fixed at one extremity and held in the hand at the other; pull gently at first, and the waves of energy will flow along the wire, disturbing the molecular oscillations, which produce cohesion, and a slight extension will take place—I leave out of consideration the actions taking place beyond the wire. Give way gently to the effort of the wire and the same waves will be transmitted back to your hand, but if let go suddenly, the effort or better waves of energy will be altered in character, producing another sort of wave motion, viz., heat. Pull again at the wire, increasing the effort gradually until it result in the rupture of the wire, then a series of waves will succeed, rapidly accumulating or reinforcing—to use an expression common in acoustics—each other so as to destroy the molecular oscillations of cohesion, there where they are least intense, producing rupture and waves of heat.

If asked on what authority I base my statement that cohesion consists of pendulum motions of the molecules, I shall reply, in the words of Professor Norton, that "No theory of molecular physics can, in the nature of things, have any other foundation than general principles to be regarded as hypotheses that have been rendered more or less probable, either by inductions from observation, or by *à priori* reasoning. Molecular physics cannot be erected, like mathematics, upon a foundation known from the first to be eternally sure, that of self-evident truths." Moreover, my statement rests not on *à priori* reasoning, but on observations rendered probable by induction. It cannot be said that I advance extraordinary statements, for the experiments published by Professor Guthrie,[1] and the later ones of Bjerknes, have prepared the road for them. Is not the experiment of Savart, of destroying cohesion in a glass tube by sound waves, and referred to by Professor Tyndall in his lectures on sound, quite conclusive?

I must now proceed to demonstrate the reason why Newton's third law is not *strictly* correct.

Consider the case of a locomotive hauling a train. As steam is admitted into the cylinders, the effort of the locomotive goes on increasing until the train starts. This first stage of progress I consider to take place as follows: Pulsations of the steam are communicated to the system—locomotive and train—they follow each other rapidly, and go on accumulating or reinforcing up to the instant when the train starts. As steam is admitted more and more into the cylinders, the train accelerates. This second stage must be viewed thus: As the pulsations of the steam continue following each other and accumulating at a greater rate than the change of character of some of them—conversion into heat—the system naturally accelerates. The acceleration goes on with the increased effort up to the moment of *apparent* uniform velocity. At that instant—just preceding this state of things—the accumulated pulsations accelerate the train; that is, the sum of the efforts is *just* superior to the sum of the resistances—in accepted terms. This acceleration naturally increases the resistances, producing an enfeeblement of the pulsations, and at the next instant a retardation will ensue. This will leave an available effort for another acceleration, and so on, these series of actions succeeding each other so rapidly as to produce an apparent equality of action and reaction, and at the same time these, acting periodically, produce also an apparent uniform velocity. Hence the notion, or rather proposition, that action and reaction are equal and opposite at every instant of time, and, as a consequence, that the sum of the efforts, being equal to the sum of the resistances, the velocity is uniform.

That this action takes place as stated above I shall prove later on, but how the accumulation of the waves takes place I cannot tell, only that reinforcement is common to all vibrations. The above action being carried on within limits so narrow as to be beyond immediate detection, has escaped observation, but if it be considered that it is the action of the steam against the piston that produces the real effort, that its energy, like that of all fluids, is manifestly that of each of its particles subject to that peculiar pendulum motion known as heat, and finally, that the fluid in the cylinder acts not bodily but by a series of impacts or pulsations of each individual particle, which transfer their energy through the connecting links of the machine to the points where resistances have to be overcome, exactly as if these particles were acting immediately against the resistances, then the conception of what I have exposed above will be greatly facilitated. Consider, more, that all bodies are formed of molecules, that the efforts to conquer their inertia must act on each molecule individually, and that although aggregated in the form of a body, they still retain their individual properties, for it is their aggregated efforts or resistances which form the effort or resistance of the whole body.

I have so far demonstrated why Newton's third law was not strictly correct; it remains now for me to state why it is practically so, and in doing so I cannot do better than quote the following paragraphs from Rankine's treatise on the "Steam Engine," which could not be better construed had he my case in view:—"If a body moves in such a manner that it periodically returns to its original velocity, then at the end of each period the entire variation of its actual energy is nothing, and if, during any part of the period of motion, energy has been stored by the acceleration of the body, the same quantity of energy exactly must have been, during another part of the period, restored by the retardation of the body. . . . Hence, *at the end of each period, the equality of energy of work, and the balance* of mean effort *and* mean resistance, *holds, with respect to the driving effort and the resistances, exactly as if the speed were uniform and the reciprocating forces nil.*" The italics are Rankine's.

I shall now adduce some experiments, simple enough, but quite sufficient to illustrate the truth of my statement: Place a thin elastic rod of wood, say about 2ft. long and ¼in. in thickness, in a stream of water flowing with a uniform velocity, so as to be immersed about 15in., and tied tightly at the other end to a sounding box. Here, then, the rod reacts against the stream, and, supposing Newton's proposition to be strictly true, the rod should deflect and there remain stationary, of course the amount of deflection being proportional to the velocity of the stream. That, however, will not be the case, the rod will begin to vibrate, and will continue so, so long as the conditions admit, producing a soft musical sound, a proof that the vibrations are periodical.

Professor Tyndall, in his "Lectures on Sound," explains in the same manner the bowing of a tuning fork, when he says:—"If you bow a tuning fork by sliding the bow perpendicularly to the prongs, these obey to the effort, and deviate from their position of equilibrium until the resistances increasing the prongs return instantly to their previous position. The bow continuing the action, a new deviation of the prongs is the result, with again an instant return, and so on. With a repetition of the periodical motions of the prongs, a state of intense vibration is obtained, thereby producing a beautiful musical sound." Professor Tyndall, in reading this, would recognise his meaning, though not his words, for I am sorry to say that I have not his work in English.

But another experimental proof and I will have done. Place a string round a pulley of a steam engine—the pulley being perfectly smooth and true—tie both extremities to some fixture, apply a sounding box to the string and press it very tight. When the engine moves slowly and at an even number of revolutions, the string being very tightly stretched, a very loud note will be heard, similar in every respect to that of the siren, the note or period of vibration varying with the speed of the engine. The engine must move slowly, for when moving fast the periods are too short to affect our hearing. I believe to be unnecessary a second explanation, for that previously given will answer this purpose.

Rio de Janeiro, June 7th. EDUARDO CLAUDIO.

[1] Phil. Mag., S. 4, vol. 41, p. 405.

MODERN MILLING MACHINERY.

SIR,—To myself and, I feel sure, to all interested in the milling trade of Great Britain, your article on the depression of that industry was one of very great interest. It is a subject on which much might be written, but I do not intend to do more than offer a few remarks and suggestions on your article. First, we must remember that millers introduced the roller system to enable them to manufacture flour of equal quality to what was imported. Now they find that they cannot manufacture flour to compete in price with what is imported. Indeed, some of the millers are worse off now than they were before they introduced the roller system into their mills. It is therefore well worth the attention of a paper of your standing to consider the causes, and how this can be altered.

My experience is this: Firstly, the pioneers of the roller system in this country made, and in some cases are continuing to make, the fatal mistake of attempting to mill the mixed wheats used in England on similar lines to the wheats of their own countries—*i.e.*, Germany and America. Secondly, these pioneers of the roller system did not confine their advice to milling matters, but attempted to advise on all engineering points, consequently nearly all the earlier roller mills erected in this country are badly planned and fitted with ill-constructed machinery, drawbacks which are very apparent in this great depression. Thirdly, foreign flour is conveyed from seaport to inland towns at a much lower rate than foreign wheat—wheat is conveyed for 13s. per ton from Liverpool to Birmingham, foreign flour 10s. a ton. If the milling trade in Great Britain is to regain its prosperity, these points and less important causes must be altered.

I cannot quite agree with you in your prophecy on the future of the milling trade of Great Britain. At present the greatest sufferers amongst millers are the owners of large mills in Liverpool, London, Glasgow, and Bristol. A small, well-situated country mill has many important advantages not possessed by mills in seaport towns. There is a better market for offals, *i.e.*, the profits in milling; it often lies in the middle of a good wheat-growing district, and the value of the land on which the mill stands is lower. In fact, many country mills can manufacture a sack of flour as cheaply as any in seaport towns. If wheat growing in this country were to die out, then mills would certainly only be able to mill at a profit in seaport towns; but the properties of English wheat, the sweet palatable taste and the preservative quality which it gives to flour, are so important that I hardly think that this will ever happen. We must not forget that the milling trade in America is even in a worse state than here.

If millers will only look to every detail in their mill, and try and manufacture every sack of flour as cheaply and efficiently as possible, and combine to correct all abuses which are crippling their trade, then I think we shall soon find that this present gloomy outlook will brighten. A. M. ROBINSON.

Mount Falinge, July 1st.

TRIPLE EXPANSION ENGINES.

SIR,—May I ask for a few words on Mr. Jennings Campbell's valuable paper on compound engines for Atlantic steamers, which appeared in THE ENGINEER of June 10th, page 471? He draws our attention to a type of engines on the triple expansion principle patented by Mr. Turner, of Birkenhead. In this Mr. Turner seeks to claim the two first and second cylinders driving opposite cranks, while that of the low-pressure cylinder is placed at right angles. In this Messrs. Turner and Campbell seek to claim a greater power. This may be logical, and it may be also true, and therefore trustworthy; but it is somewhat late in the day to attempt to dress it in the garb of a new discovery, more so since that eminent firm of engineers, Messrs. J. and G. Rennie, have had several exhaustive trials with cranks placed in above and at different positions, the account of which appeared in the columns of THE ENGINEER some years back.

Although as long ago as 1862 Mr. John Elder patented the triple and quadruple expansion engine, it never was introduced by that firm into any ship whatever. Until the year 1874 the manager of the firm named, Mr. A. C. Kirk, now of the firm of Messrs. R. Napier and Sons, of Glasgow, had designed the triple expansion engines of the Propontis, which are still doing good work. It was the success of the Aberdeen on the long Australian voyages that showed shipowners the economical advantages to be attained by triple expansion. Since the success of the Aberdeen many engineers have brought forth and patented the triple expansion engine in different forms, and with no greater success than that of Mr. Kirk's, and I know that there is a great improvement in the triple expansion engine to be brought out yet. I am rather of opinion that too much stress is laid upon the position the several cranks may bear to one another, and would suggest to Mr. Campbell and others interested that a great loss of power is to be found in the vicinity of the stuffing-boxes through the unnatural strain caused by unnecessary packing, and would further refer them to Mr. David Robertson's anti-friction stuffing-boxes, and recommend a careful study of the same. I may add that I have seen one of these boxes in use on an engine for over two years now, and the rod still remains the same as the day it came out of the lathe, while there is not much provision made—on this one—for lubrication; and the friction in the absence of packing has been reduced to the lowest possible minimum, resulting in allowing the cranks, in whichever position it may be found necessary to place them, to fulfil the proper functions required of them. I apologise for trespassing upon your valuable space. ROBERT S. LAWRENCE.

20, Inglefield-street, Glasgow, July 2nd.

TORPEDO BOAT BOILERS.

SIR,—I have seen your article of the 27th May on "Torpedo Boat Casualties," and also a letter on the same subject in your number of the 17th June from Mr. Donaldson. I think that the question of staying the crown of the fire-box of such a boiler has been pretty well settled by the universal practice of locomotive engineers, who always use bolt-headed or rivetted stays. Mr. Donaldson has only to look at the numerous illustrations of locomotive boilers to see that they are always stayed in this way. The Belpaire fire-box is a good example, as it is very similar to the torpedo boat fire-box, the top of the outside casing being flat, and the stays having bolt-heads on one end and a nut on the other. I do not know what experience Mr. Donaldson has of boilers of the locomotive type, but I think it would have been much wiser to have copied the best examples rather than adopt a system of staying which has nothing to recommend it. There really is no value in the argument that other boilers stayed in a similar way have not failed, either because they have been seldom in use, or have not been short of water. You might as well say that because trains have often run over broken rails without leaving the line that therefore broken rails are safe. I should say that in the design of a boiler it is certainly necessary to contemplate a case which, although it rarely arises—arises quite often enough—the burning of a fire-box. Even with locomotive drivers, who are probably the most skilled and careful enginemen, fire-boxes are burnt quite often enough to make it absolutely necessary to consider the case. It is to meet such cases when the boiler is short of water that fusible plugs are used, and if there had been fusible plugs in these boilers they probably would have saved the fire-boxes from being burnt. M. A.

HIGH-PRESSURE MARINE BOILERS.

SIR,—One would have thought that your article on "High-Pressure Marine Boilers," which appeared in your impression of the 17th ult., would have given birth to a lively correspondence between engineers interested in the subject. If stronger boilers are required as you anticipate, you well know that engineers, in attempting to produce them, will abandon the present dimensions only as a last resort. If a shell over 1½in. thick cannot be produced with present plant a larger will have to be laid down, or the shells will have to be cast to shape in cast steel, plant to do which is already in operation at more than one of our large steel works. For myself, I cannot see that there will be any objection to using a cast steel shell, rather the other way. It has an advantage over the ordinary shell, inasmuch as, being solid, the metal would be evenly distributed, and consequently lighter in weight. This point alone is a consideration that should command the interest of engigineers, and particularly the Admiralty, as 10 to 20 per cent. weight saved is a serious account with them. It may be urged that it is not a suitable material for boiler shells. One would think that if it is good enough for cylinder liners, it would be for shells. Theoretically there is no limit to the dimensions of a shell that can be made in cast steel. So boilers, so far as the shell is concerned, can be made of any strength required.

With regard to corrugated flues, which you seem to think will prove such a stumbling-block against the use of higher pressures, that the universal type of boiler will have to be put on one side to make way for some other type that has not yet recommended itself or seen the light of day, in this week's ENGINEER there appears a letter from Mr. H. P. Fenby, of Farnley Forge, who confidently assures us that corrugated flues will hold their own against any pressure up to 250 lb. per square inch, whilst retaining a factor 4 of safety. Whether the well-known corrugated flues will stand their ground or not I will not venture an opinion; but I may add that there is a new flue lying in Liverpool that is very soon to be subjected to a collapsing test. Great results are expected, and if the owners obtain the success they anticipate, there will be no obstacle in the way of using the high pressure of 250 lb. per square inch, so far as the flues are in question. But what is this we hear about a new steam generator invented by Dr. Blum, LL.D., an invention that is going to revolutionise creation? It is claimed that it will save 53 per cent. in fuel, 96 per cent. in boiler space, and 66 per cent. in the cost of plant; and, moreover, a boiler explosion is to become an impossibility. If this startling report be true, there will be no more need for boiler shells or flues, as they will be booked to limbo, whence no return tickets are issued.

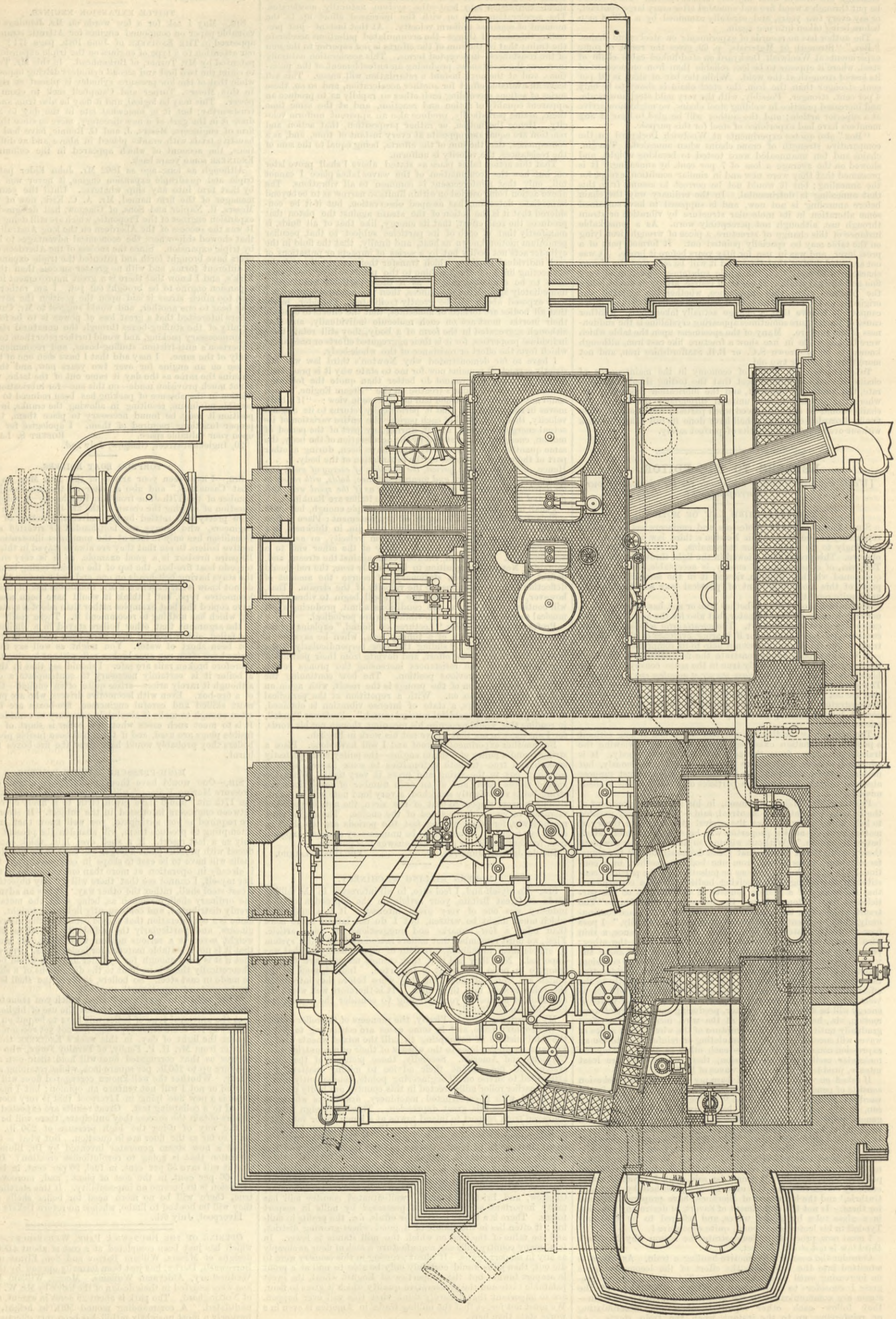
Liverpool, July 6th. BOILER.

OPENING OF THE BRUNSWICK PARK, WEDNESBURY.—This park, which has just been completed at a cost of about £6000 from the designs of Messrs. William Barrow and Son, Elvaston Nurseries, Borrowash, Derby, has just been formally opened by the Mayor of Wednesbury, Alderman Williams. Messrs. William Barrow and Son were assisted in their design of the lodge by Mr. W. H. Radford, of Nottingham. The park is about 25 acres in extent, and is finely undulated. A commanding mound 50ft. in height, which was formerly a most unsightly pithill, has been very effectually treated. Two lakes have been constructed, and a cricket ground, tennis lawn, bowling greens, band stands, shelters, &c., provided.

COMPOUND DIRECT-ACTING PUMPING ENGINES, HAMPTON.—PLAN OF ENGINES, PUMPS, AND HOUSE.

MR. J. W. RESTLER, M. INST. C.E., ENGINEER; MESSRS. RICHARD MORELAND AND SON, CONSTRUCTORS.

(For description see page 13.)



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CONTENTS.

TO CORRESPONDENTS.

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

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

*** *Several interesting articles and letters we are compelled, through pressure upon our space, to hold over until next week.*

R. T. C.—*Will reply in a few days.*

D. J. W. (Ottawa).—*Copy sent, but you forgot to pay the postage of your letter.*

J. B. L. (Bermondsey).—*The resistance you name has nothing whatever to do with the calculation of the indicated horse-power.*

F. R.—*You would lose all the benefit of expansion, and your difficulty would be practically insurmountable. A little dirty steam would soon prove it for you.*

R. M. (Salford).—*Of course the outer wheels of the locomotive travelling round a curve go over more space, though they do not revolve more rapidly, than the inner wheels. The difference is made up by "slip" on the rails.*

CORRECTIONS.—*In our notice last week of the pumping engines at Hampton we named, as the constructors, "Messrs. S. Moreland and Co." We should have said Messrs. Richard Moreland and Son, of Old-street, London. And, with regard to the article on "Cotton Pressing in Egypt," which lately appeared in* THE ENGINEER, *and which we ascribed to Mr. William Turner, of Manchester, that gentleman is wishful that we should state that the article was really not written by him, but by an engineering friend in Alexandria. It was an interesting paper, whoever wrote it.*

BORING MACHINERY.

(To the Editor of The Engineer.)

SIR,—On page 430 of your issue of May 27th reference is made to a bore-hole put down for salt. The hole, 8in. in diameter and 1096ft. deep, was bored in twenty-eight working days by the American boring process. I should be glad if any correspondent can give me particulars of the system employed, or the name of any firm who would undertake the work.

SELBATS.

July 5th.

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THE ENGINEER.

JULY 8, 1887.

THE INSTRUCTION OF ENGINEER OFFICERS IN THE NAVY IN HYDRAULIC GUN MACHINERY.

THE increase in the weight of modern naval guns, with their charges and projectiles, has placed their control and efficient working beyond the capabilities of manual labour, and has necessitated the resort to steam power. The machinery most suited to the purpose of controlling, working, and loading heavy ordnance, both muzzle and breech-loading, has hitherto been almost exclusively designed and manufactured by the firm of Sir W. G. Armstrong and Co., of Elswick, and is of a costly and extensive character; involving first, steam power for obtaining a pressure of water; and, secondly, a series of water-pressure machines, with the necessary pipes and valves. Previous to such extended application of steam power to gunnery purposes, and while guns were comparatively light, almost the entire responsibility for the working efficiency of the gun mountings rested with the gunnery officer, with only a very occasional reference to the engineer. But with the altered character of gun mountings, the responsibility of the engineer in connection with them has necessarily very much increased. The responsibility for the proper use of these machines of necessity falls upon the officers of the gunnery branch, whose duty it is to direct and drill the various guns' crews. The duty of maintaining the efficiency, and the proper preservation and repair of these machines, however, is made to fall upon the engineer officers. In order that the latter, on being appointed to ships where these modern appliances have been provided, may not find themselves called upon to be responsible for novel machinery, the precise character and design in detail of which they have had no previous opportunity of considering, it has been arranged that classes of engineers are to be formed four times in each year on board H.M.S. Excellent, at Portsmouth, for the purpose of instruction in hydraulic machinery for heavy guns. The same classes of officers also receive instruction during seven weeks in the special machinery connected with torpedoes and electric lighting. The instruction in the two latter subjects is given entirely by officers of the engineer branch; while, in the case of the hydraulic machinery, the engineers are subjected to the professional indignity of being placed under the instruction of an officer of the executive branch. Some time ago, an engineer officer having a special knowledge of the subject, was appointed for instructing engineers in the hydraulic machinery, but for the first year, although the engineer officer held the appointment, no arrangement was made for him to carry out the duty. The Admiralty, however, formally directed that the engineer was to perform the duty for which they had appointed him, and as the result of a subsequent attempt to minimise the scope of the engineer, both as to time and matter, the Admiralty laid down a syllabus, and fixed the time at two weeks. Instead, then, of the instruction of the engineers being left in the hands of an officer of their own branch—as is the case in the torpedo and electric light courses—the length of the hydraulic course has been doubled, and now consists of the same course as formerly given during two weeks by the gunnery lieutenant, followed by a course of equal length by the engineer. That it is of the first importance that the officers who are responsible for the proper use of the various machines should be thoroughly acquainted with their action, and to some extent with their construction also, is indisputable. The comparatively simple character of the machines devised for working heavy guns enables any man of average intelligence, with an interest in the subject, to acquire a very clear notion of their action and arrangement. Their use is so extremely simple, and they are so safeguarded from injury in use by the natural brake action of the water employed to actuate them, that considerable success and efficiency in working them may be acquired with very little practice and without any previous training in the use of machinery.

From a constructive point of view, however, these machines are in many cases complicated. It is consequently in connection with their preservation and maintenance, or in dealing with an injured or defective machine, that the knowledge, skill, and general mental habit of the engineer is most essential; and although the use of such machines may be readily acquired, a ready and practical knowledge of the principles involved in the construction and design, the nature of the materials, and the methods of manufacture, are matters which can only be acquired—at least, by the average intelligence—by means of a systematic training and long practical experience. Not long ago an officer at the United Service Institute, at a meeting held there, instanced the fact that gunnery lieutenants were employed to instruct trained engineers in hydraulics, as proving their professional superiority. It is needless to say that this so-called instruction from a lieutenant has always been received with great dislike by the engineers, and is looked upon by them as a professional indignity unnecessarily thrust upon them. If a lieutenant, however valuable his amateur attainments might be, were appointed to instruct, say, classes of surgeons in some branch of surgical knowledge, it is not improbable that both the instructor and the instruction would be very ill received, whilst general public sympathy would not be difficult to excite in favour of the surgeons' view of the situation.

In the case of the engineer officers of the Navy, disciplinary and other considerations, combined with a hope that the thing would right itself, have tended to promote among them a very patient demeanour. But it is not difficult to perceive that the very natural resentment caused by this instruction in machinery by an officer who cannot in any way be regarded as a mechanical engineer, excites feelings hardly conducive to the ready pursuit of the subject or attention to the instruction. Nor is the embarrassment wholly on one side. The instructor also on his part cannot but feel the anomalous character of the situation. In this way a feeling of restraint on both sides, resulting in a waste of both time and effort, although very much to be regretted, is inevitable from the nature of the case. But in order not to be wholly without some excuse for their persistence in a course which certainly requires some apology, it is usual on the part of the gunnery lieutenant instructors to protest that they are merely dealing with the subject from a gunners' or artillerists' point of view, while in reality their general treatment of it approaches more nearly that of the mechanical engineer. But of what advantage to an engineer can it possibly be to consider a steam engine or pump, or hear the action and construction of its parts explained from an artillerist's point of view? Yet such explanation forms a considerable portion of the lieutenant's course of instruction. In what useful aspect for the purposes of maintenance or repair, so far as the engineers are concerned, can the engines for revolving turrets be regarded from a gunnery lieutenant's point of view?

The Admiralty are at considerable expense to ensure that the mathematical consideration of hydraulics, as a theoretical study extending much beyond the requirements of simple pressure machines, shall form an important part of the training of engineer officers; and this, taken in conjunction with their six years' workshop training, their knowledge of the propulsion of ships, the use, construction, and behaviour of the centrifugal and other varieties of pumps connected with marine engineering, certainly affords naval engineers an experience of hydraulic machinery which should save these officers the infliction of the gunnery lieutenant's point of view. From an engineering point of view the claim on the part of the executive officer to instruct engineer officers in certain machinery because it works the guns is about as well founded as would be a similar claim to instruct them on the steering engines, because they work the helm, or the main engines because they propel the ship, and is as unreasonable as is the apprehension, by no means unknown in naval circles, that the engineer aims both at steering the ship and working the guns. Without in any way wishing to detract from the ability and credit due to the gunnery instructing lieutenants in making themselves acquainted with the machinery of modern ordnance, we may say that machinery is so essentially an engineering question that, for the purpose of instructing an engineer, it is, one would think, self-evident that the subject is best dealt with by an engineer—their common training and experience enabling the engineer's instructor best to appreciate both what his brother engineers know and what they require to know.

For maintaining the efficiency of our modern fighting machines, the knowledge and methods only to be acquired by means of the training of the engineer are most essential. That the growing importance of this knowledge should have, at last, made the possession of it attractive to these officers whose training has been directed to entirely different, though equally important matter, is not perhaps surprising, but that it should give rise to interdepartmental friction, and a sacrifice of true efficiency, is nothing less than a calamity. The lesson the gunnery officers of to-day appear yet to have to learn is that gun-mounting is a subject of sufficient extent and importance to afford useful and satisfying scope for the knowledge and efforts of both the artillerist and the mechanical engineers at the same time; and that a man may successfully and ably use a machine just as he may successfully and ably use a chronometer or sextant without claiming to be either able to make or to repair it, much less to instruct trained instrument makers as to its construction. In conclusion, we maintain that the instruction of engineer officers in hydraulic machinery, as applied to guns and gun mountings, should be carried out wholly by an engineer. Thereby the engineer officers will not only be relieved of what they can only regard as a professional slight, but the instruction itself will be rendered more effective.

THE DEFENCE OF COLONIAL HARBOURS.

WHEN the Commission on Colonial Defence made its report after a long term of diligent inquiry, it was naturally concluded that its recommendations, although kept secret, and wisely so, from the outside world, would be fully adhered to when the time came when effect could be given to it. The Legislatures of our several Colonies voted money freely for the execution of the works which had been stated by experts to be vital for the defence of their principal harbours; and we have seen, besides, how readily those of Australia have fallen in with proposals made to her for strengthening her system of naval defence. It seemed reasonable to conclude, therefore, that every necessary step had been taken to ensure that before very long ample provision had been made to afford full protection to the chief points open to attack within our Indian Empire and our Colonies. It is therefore disheartening to learn that, whether it be from niggardliness on the part of the chief administration, or from the incompetence of those to whom the design and execution of the contemplated works has been entrusted, there is much reason to think that the conclusion was premature. It is not from one alone, but from many of our Dependencies, that we receive information which goes to confirm this fear. We learn that the guns provided at Bombay, Gibraltar, Trincomalee, Hong Kong, and other equally important stations, to be mounted on the new fortifications, are in many instances of a type far below the standard of first-class modern artillery. While a few breech-loaders only have been provided, the greater proportion of the newly supplied armament is of an almost obsolete muzzle-loading description. Even at such an important station as Gibraltar, we learn that there are but two or three guns, at the most, of a kind adequate to cope with the artillery borne by the ships of the great Continental Powers. For some time past these complaints have appeared in the letters of Colonial correspondents to the home journals, and they have been urged with a per-

sistency which scarcely leaves room for doubting that they are based upon facts which do not admit of contradiction by the authorities. It is certain that such contradiction has, at all events, never been made. When questions on the subject have been put in the House of Commons, they have been answered in a generalising fashion which left much to be desired. Those answers have certainly failed to assure the public mind. It may, of course, be said that it would be an unwise policy to proclaim the character of the armament to be mounted at any particular port, and it is behind such a plea that hitherto our Ministers have sheltered themselves in their explanations. But no argument of that kind could be advanced against a statement in full of the description of the entire armament already prepared, or in preparation, for the whole of our Colonial ports generally. Such information would be of no use to those who might seek to make inimical employment of it; while it would assure us as to the relative number of efficient guns to be supplied, as compared with the number which have lain for so many years unissued from our arsenals, which the lapse of time has now rendered comparatively useless. The letter of a correspondent of the *Times* furnishes us with a strong example of the nature of the complaints which we have stated to have become so common. If there be one port more than another throughout Great Britain's Eastern Empire which we might expect to learn was most fully defended, it would be Bombay. But what are the facts as to the condition of the defences of that most important harbour? It is described in the letter above-named as being "so inadequately defended as to be really worse off than if no attempt had been made to fortify it!" The guns in one of the chief batteries are described as being "all of the old muzzle-loading pattern, with an extreme range for the heaviest natures of about 5500 yards." We need quote no further from this letter, but we note the entire absence in it of any mention of a single gun efficient against the distant firing of ships throughout the whole of the armament of the Bombay fortifications. If such be the condition of the defences of one of the most important harbours of the East, it may be naturally inferred that others which, as compared with Bombay, are of secondary importance, are no better off in respect to the mounting of that modern artillery which can alone at the present day be held to be efficient. If the plea is raised that Woolwich is unable to meet the demand made for guns of modern type for the extension of defensive works in India and the Colonies, we can only say that there are private firms able and willing to make good the shortcoming. It is manifestly a weak and indefensible policy to send out to distant stations a useless armament simply because it is in reserve in our arsenals. The cost of doing so is a mere waste of public money, and the action raises besides an impression of security which cannot be justified, and may some day prove disastrous.

Turning from the question of armament to that of the construction of the fortifications themselves, we do not find much ground for congratulating ourselves. General Sir William Crossman recently asked a most important question in the House of Commons relative to the quality of the cement supplied for the fortifications at Trincomalee. That question implied that 300 barrels had been found to be useless, and that 2400 more were of "most inferior quality." The reply given to this question was of a most singular character. It revealed either that the statement made was correct or that the works themselves were in most incompetent hands. While admitting that a not inconsiderable portion of the supply was altogether worthless, it was alleged that the condemnation of the larger quantity referred to was due to insufficient knowledge as to the proper application of the tests on the part of the officer superintending the work at Trincomalee. Truly, this must be held to be an admission which must greatly shake our confidence in the future stability of masonry upon which large guns of position are ultimately to be placed. If not only our guns are feeble, but their supporting works are open to the liability of failure whenever those guns are fired, we are in a "parlous" state, and the sooner steps are taken to stay the supply of inefficient armament, as also to provide officers competent to execute works destined to mount the guns, the less likely will it be that we shall hear it asserted that the large expenditure now incurring for Colonial defence is being thrown away.

PRIMING.

A very great deal of uncertainty prevails on this subject, and considering the sometimes anomalous results that are observed, surprise cannot be felt. Plenty of steam room and good circulation seem to be the generally acknowledged conditions for securing a good result, but of these two, probably the latter is the more absolutely necessary. A small amount of priming is experienced in nearly all boilers at times, which seems to arise from alteration in the surface tension of the water in the boiler, due to scum from earthy matters, which may be present alone, or in combination with fatty acids; the trouble usually disappears quickly on the surface blow-off being opened for a short time. In marine boilers priming is frequently experienced when changing water in passing from dock to river, or from river to sea, and, of course, is in these cases confined to vessels using jet condensing machinery, or having leaky surface condensers, wherein the feed-water is contaminated by the outside water. Priming arising from these causes alone is, however, small in amount and easily controlled; but when it acts as an exciting cause to the more serious form due to imperfect or bad circulation, the situation may be one of very great danger, as it is almost sure to occur when the fires are being urged. The circulation at low rates of steaming is frequently very fair in many badly designed boilers; it is when the final effort is to be made that the trouble arises. It may be said that this is only another way of saying that boilers should be made large enough for their work, which is perfectly true. Engineers, however, have seldom the weight and space at their disposal to adapt the principles of land boilers to locomotive or marine practice, and they have to consider how to get the most duty out of a given amount of material and space. The circulation of water in a boiler must depend entirely on the difference of density of those portions giving off the most and the least steam, the water being, as it were, honeycombed; therefore the necessity for allowing suitable water spaces at the less highly heated portions becomes obvious, so that gravitation may tend to supply those portions of the heating surface that are doing the highest duty, and when the water is in consequence least in average density in the water spaces. Water-tube boilers have failed from this cause as much as from structural defects, the difficulty of ensuring a proper circulation through each of perhaps several hundred tubes being very great. In the case of such as become badly filled, overheating and subsequent rupture takes place. With steam of higher pressure, or, in other words, of greater density, the influences that cause circulation are lessened, as the difference in weight of the ascending and descending columns of water is not as great.

Circulating plates, judiciously arranged so as to separate the various currents, to a certain extent remedy the troubles due to imperfect circulation, but their effect is limited; the best means, especially in boilers using high pressures, of ensuring good performance, is to provide plenty of water surface and steam room. A good example of the method to be employed in boiling a troublesome mixture is shown by a process introduced a few years ago in connection with brewers' coppers, where an inverted funnel-shaped appliance is placed in the wort, reaching nearly to the bottom of the containing vessel. By this means all the steam, or very nearly all, is collected, and the wort, which ordinarily foams up as soon as it boils, is constrained to circulate with great rapidity, giving off its steam as the liquid flows over the upper and smaller part of the funnel, which is above the normal height of the fluid several inches. The liquid having parted with its steam in suspension, by its superior density displaces in its turn the lighter and ascending columns continuously. As affecting marine boilers, this principle had been anticipated, and was in actual operation in some of her Majesty's vessels. In these cases, as well as in some private vessels where the system was tried, the result was, on the whole, very satisfactory. The curious property of injected grease encouraging priming in locomotive boilers and hindering it in marine boilers of the box form has often been noticed, and is only mentioned here as a curious paradox. On all sides it is agreed as of the first importance now-a-days to keep grease out of the boiler as far as practicable, owing to the troublesome compound which it forms with any precipitated lime or other earthy substances. When deposited on the furnace crowns and tube plates great danger may arise. Even its presence on the boiler shell at or about the water level is considered by many engineers to induce priming, especially in locomotives when the water level is rather closer to the top than in some other varieties of boilers. The present practice of using short tubes in the low or navy boiler, where employed with forced draught, does not seem to be producing good results, judging by some reports of recent sea trials. There can be little doubt but that flame is driven nearly, if not quite, through the tubes by the air blast, and their whole length, more or less, actively engaged in evaporation. If the side water spaces are not sufficiently large to permit active circulation, it is difficult to see where the downward current is to be accommodated to the necessary extent for quickly replacing the water on the steam raising part of the heating surface. Although in some text books it is the fashion to say that only the first foot or so of the tube length is efficient for steam making, that person would be a rash one who supported his theory by making a locomotive boiler with tubes, say, two or three feet in length. Boilers of a character tending in this direction are now afloat, but their performance does not seem to be encouraging. The practice among our leading torpedo boat builders is decidedly averse to short tubes in their boilers.

OUR STEAMSHIP POWER.

The blue-book, just issued, on the "Navigation and Shipping of the United Kingdom," contains a table which will greatly interest those who wish to observe the changes in the merchant fleets of the nation. It shows for several years what we have shown for occasional months, from other sources, in The Engineer—the tonnage of vessels added to the register, and that removed. The summary is for five years, and there are two unvarying features running through the whole—the number of sailing vessels has decreased every year, and every year the number of the steamships has increased. The decrease in the number of sailing vessels on the registers of the ports in the United Kingdom has been in the last five years 412, 462, 337, 960, and 830 respectively, and the decrease has been contributed to by every port of the United Kingdom. The tonnage removed on balance has fluctuated more in proportion, but it is still year by year decreasing, the decrease being the least in 1885, when only 5171 tons were removed from the registries, and it was most in 1883, when the loss was 105,583 tons. Coming to the steamships, we find that the numerical increase has year by year been less and less. In 1882 there were 303 added after the loss was made up; in 1883 the largest addition was made by 446 steamers; in 1884 the addition was 339; in 1885 it was 41 only; and last year there were only 9 added, when the number of those removed was made up for. In regard to tonnage, there was an addition in the year 1882 of 350,518 tons; in 1883, of 393,334 tons; in 1884, of 215,827 tons; in 1885, of 28,672 tons only; and last year there was a decrease of 7982 tons of steamers. In all the years reported on, then, we have decreased the total numbers of the vessels of both kinds by about 1860; so that numerically our fleet is much smaller than it was, though the increase of the steamships, included in the total, makes the fleet more effective. Last year, however, witnessed a considerable decrease in both the sailing vessels and the steam tonnage, over 65,870 tons of the two classes being removed from the register; whilst the fact that a ninth part of this was steam tonnage renders the loss greater in working power. There has been a theory held by the owners of steamships, that in the first three of the years named there was an over-production of vessels; but if this were so, the fact is now established that last year saw not only a check to it, but an actual reduction of the tonnage, and that reduction is now still proceeding. The loss of vessels is so great that it more than balances the small amount of building which is in progress; and until there is a better state of relationship between the owners of the steamers and the managers thereof, capital will not flow into the steam shipping trade as it did. This is really the cause of the reduction of tonnage. As that eases the competition in the freight market, the results to the owners will be better, but it will be some time before there will be building enough to more than replace the losses which take place. The over-production is working out its own cure, and in time there will be fuller employment for our shipbuilders and engineers.

A CANAL CONNECTING TWO SEAS.

The project of connecting the Mediterranean Sea and the Bay of Biscay, by means of a canal traversing the South of France, has often been under discussion. Without entering into the political considerations set forth in a pamphlet just published by M. E. Couillard, the *Annales Industrielles* points out certain advantages to France to be obtained by the realisation of such a scheme. In the case of a maritime war, the Strait of Gibraltar could be avoided; Brest and Toulon would be rapidly brought into prominence; the concentration of troops would be effected more easily; and the prestige of England considerably lessened. From an industrial and commercial point of view, the canal between the two seas would shorten by several days the distance between the English ports, the North Sea, and the eastern basin of the Mediterranean, and the extreme East. The dues levied upon the ships passing through the canal would be amply compensated for by this economy of time and the security gained by avoiding the stormy coasts of Spain and Portugal during the winter months. The ports of Bordeaux and Marseilles would also gain considerable importance, and the increase of traffic that would ensue on the principal lines would greatly profit the railway companies. The most rational route would be from Bordeaux to Cette by Agen, Montauban, Toulouse, Carcassonne, and Béziers. From Bordeaux the canal would generally follow the course of the Garonne, passing on its right bank; it would tap the Dorpt, the Lot, the Aveyron, and the Tarn, and either draw its supplies direct from their waters, or through the creation of vast reservoirs. After passing Toulouse, it would run the course of the South Canal, would pass by Béziers, and terminate in the Lake of Thau, which would be transformed into an inland port, and take, from a defensive point of view, the same position on the Mediterranean as the estuary of the Garonne on the eastern coast of France. Both on account of convenience and economy, the canal should be established at sea-level, with a simple system of tide gates, avoiding the expensive construction of locks. Under the present financial conditions, the carrying out of so vast a project presents some difficulties, but the public have always been willing to subscribe for any great scheme such as the Suez and Panama Canals, and for one so essentially French, our contemporary believes that funds would be readily raised.

THE CANADIAN TARIFF.

The Canadian tariff question holds the field against all others in the attention which it is now commanding from iron and steel masters. The questions asked in the House of Lords on Saturday is evidence of this. Peculiar interest attaches to views upon the tariff which have just been expressed by one of the leading steel and ironmasters of America—Mr. Andrew Carnegie—who is at the present time in this country. Mr. Carnegie is mainly concerned in steel rail manufacture, and he declares that the Dominion duties are of very secondary importance to the American iron and steel masters compared with the importance which they are to our own iron and steel manufacturers. The business which America does with Canada in these commodities Mr. Carnegie urges is very small, and he would have it believed that so long as the present great difference in prices between English and American iron continues, but little change in the relative position of the two countries is to be anticipated. Steel rails in America to-day are 40 dols. per ton. In England they are half the price. The yearly average value of rails and rail fastenings sent to Canada by the United States during the last ten years was only £74,000, against £445,000 from Great Britain. "America does not want foreign markets," is the pronouncement of this American steelmaster under this head. She has, he states, more than she can do to supply her own demand. Mr. Carnegie's firm alone will turn out this year over 300,000 tons of steel rails; and, including other products, a total of 500,000 tons of finished material. Overflow orders for steel rails from the States are in hand in this country. Our steelmakers have every reason to look for a continuance, for the present at any rate, of the large Canadian custom. Steel rails are still to be admitted duty-free, and several years must elapse before Canada will be ready to supply her own needs.

LITERATURE.

Particulars of the War-ships of the World, extracted from the Universal Register for the Year commenced 1st April, 1887. Issued by the Committee of Lloyd's Register of British and Foreign Shipping, 2, White Lion-court, Cornhill, E.C.

The widely extended organisation of Lloyd's Register of Shipping, with its large staff of surveyors to be found in every important seaport of the world, affords exceptional facilities for the collection of accurate statistics regarding all that pertains to shipping. Until a year or two ago the Committee of that society had confined their attention almost entirely to the classification of ships surveyed by their own staff, and their Register Book was chiefly valued on account of the information it furnished regarding classed vessels. It is true that during the course of ten or eleven years previously the Register Book had been amplified with lists of shipowners, their addresses, and the vessels they owned, particulars of dry dock and slips, and a tolerably complete record of that portion of the world's merchant shipping which was not classed in their Registry; but all these statistical efforts were wholly eclipsed last year by the issue of the *Universal Register*, which was duly noticed in our columns at the time. The Committee have now sent out the second issue of that Register, a volume which even excels its predecessor in the extent and accuracy of the information it yields. The work before us contains particulars extracted from the *Universal Register* relating to the war ships of the world, and it is supplemented with tabulated lists of the world's mercantile shipping of the most complete, interesting, and instructive kind.

The war-ship list is believed to be the most complete

and trustworthy published in any country, and is the only periodical one issued in the English language. It contains particulars of the war-ships belonging to every nation in the world possessing a navy, and these particulars are of the most precise and valuable character. The ships are classed according to their several types and functions, and regarding each we learn what is the material of the hull, number of screw propellers, nature of rig, where built, when launched, displacement in tons, principal dimensions in feet, thicknesses of armour on belt, battery, turret, citadel, barbette, &c.; particulars of armament, indicated horse-power, coal capacity, and speed. Then, in addition to these general lists, we are supplied with analytical tables as follows:—(1) The guns carried by the world's war-shipping, the details having in most cases been supplied from official sources. (2) A list of war ships, arranged according to speed, nationality, and displacement. (3) A list of sea-going armour-clads, and deck-protected ships, arranged according to the estimated power of their heaviest guns to penetrate unbacked iron armour. (4) A similar list to the foregoing, relating to coast defence armour-clads. (5) A list of sea-going armour-clads, arranged according to the resisting power against penetration of their armour. (6) A list of deck-protected cruisers, arranged according to the thicknesses of their decks. (7) A list of coast defence armour-clads, arranged as in the fifth list. Over and above all this, another list gives the signal letters assigned to all the war ships of the world, and, as already remarked, the volume concludes with a series of statistical tables, nine in number, relating to the world's mercantile shipping.

It is impossible to speak too highly of the manner in which the compilers of this work have performed their task. The tables afford just such information as is sought by all interested in war and mercantile shipping, and no more. The classification and analyses have been performed in the most intelligent manner, and it is abundantly clear that the Committee of Lloyd's Register are able to command the services of men who are not merely mechanical compilers, but who possess a clear and precise acquaintance with naval science, and are fully alive to what a war-ship has to do, and how she is expected to do it. In their preface to the war-ship tables the Committee have furnished reasons for the several bases of comparison between ship and ship adopted by them in their analyses. The relative value of each function of a ship has been assigned with judgment, and the advantages possessed by each type for the performance of its special duty have been correctly understood. So clearly is this the case, that one would rather suppose this work had issued from the Admiralty Office, than from a voluntary association primarily concerned with the classification of mercantile shipping and machinery. Even upon the subject of naval ordnance and the criteria whereby the relative value of different descriptions of marine artillery may be determined for purposes of comparison, the compilers of the tables seem to have been as much at home as when figuring up their statistics of shipbuilding at the conclusion of the work.

The particulars and summary regarding all the guns afloat in the world's war-ships show us that Great Britain alone possesses ordnance capable of penetrating 36in. of unbacked iron armour, and of these she has six. The guns in question are, of course, those of 110 tons, such as have just been put on board the Benbow, and the tables inform us that they are Armstrong breech-loaders discharging a projectile of 16·25in. in diameter, weighing 1800 lb., and requiring a charge of 1000 lb. of powder, the muzzle velocity of the projectile being 2128ft. per second. Without going fully into the very interesting data furnished under this head, it may be remarked that while we have twenty-two guns capable of penetrating 24in. and upwards of unbacked iron, France has twenty-eight, Italy twenty, Russia twenty, and Spain two. So that although our six best guns can penetrate 36in. of iron, yet the twenty guns of Italy are equal to 33in., and in the total of thick armour-piercing guns we are not so far ahead of any of our neighbours as would appear desirable, while in regard to France we are actually behind.

The classification according to speed furnishes some very interesting results. Of 20-knot ships and above England and France have each only one, while Italy has ten, Spain two, and other Powers four. When we come down to 19 knots, however, we are relatively better off, having eleven of such ships mounting eighty-eight guns, as compared with ten French ships of sixty-eight guns. Germany and Italy have, respectively, three and two such vessels, and other nations nine. Of 18-knot ships, England has five of fifty-eight guns, France seven of five guns, Italy six of sixty guns, Germany two of twenty-eight guns, and other Powers six of twenty-four guns. It is in the matter of 17 and 16-knot war-ships that England shows to greatest advantage, having of the former twenty-five of 181 guns, while France has four of twenty guns, Italy five of fifty guns, and other nations four of nineteen guns; while of the latter we have eleven ships of ninety guns, as compared with three of France, four of Germany, four of Italy, and fourteen of other Powers. Summarised, it appears that of 14-knot ships and above England has eighty, France sixty-nine, Germany thirty-five, Italy forty-one, Spain eighteen, and other nations 105.

The summary of the tables relating to the penetrative power of the heaviest guns carried by sea-going armour-clads and protected cruisers shows that England has fifteen ships carrying guns able to penetrate 18in. of unbacked armour, while France has sixteen, Italy ten, Russia six, and other nations nine. If the still lower limit of 12in. of iron be selected, it seems that England has fifty-five ships, France eighteen, Italy seventeen, Russia four, and other nations sixty-six ships carrying guns capable of its penetration. From these figures it is clear that whatever may be the merits of the Admiral class or those of the Trafalgar type, we need more big ships in order to put us on a level with France.

After classifying the world's war-ships according to the penetrative power of their guns, the compilers of these tables have very properly given us the other view of the case by stating the particulars of sea-going and other armour-clads as regards the resisting power of their armour. From the summary which follows this table, it seems that of sea-going armour-clads with side armour equivalent to 18in. and above of unbacked iron England has fifteen, France twelve, Italy ten, Russia three, and other nations three; while if we descend to 7in. and above, we find that England has thirty-six, France sixteen, Italy two, Russia thirteen, and other nations thirty-two ships provided with armour of that resistance.

It is impossible, however, to do justice to these tables by such extracts as we have presented. The lists must be studied in their entirety to be understood, and in no other way is it possible to gather from them the valuable lessons which they teach. Not only to naval officers and officials, but to the public generally who are interested in the state of our defences and are anxious to know how we stand in regard to our possible adversaries, this work will prove of great value; and should any naval war break out in which we were unhappily involved, there can be no doubt that its contents would be eagerly consulted by a huge body of readers who, under ordinary circumstances, are content to let the Navy "gang its ain gait."

The statistical tables relating to our mercantile shipping are of the same kind as was presented in the first issue of the *Universal Register;* but are, of course, corrected up to date. The particulars given upon Table No. 9, which concludes the volume, are significant of the unique position at present occupied by Lloyd's Register as a classification society. Of the 465,155 tons of steel and iron sailing and steam ships built throughout the world in 1886, no less than 369·524 tons—or nearly 80 per cent. —were built under the survey of Lloyd's surveyors, and classed in their Register Book. The United Kingdom produced 397,402 tons out of the total of 465,155 tons, so that the tonnage classed at Lloyd's was nearly 93 per cent. of the total built last year in the United Kingdom. When to the primary duty of mercantile ship and machinery classification is added the further tasks of yacht classification, the assignment of freeboards, the testing of steel at the manufactories, the inspection of ship and engine forgings and castings, the survey of unclassed yachts at owners' request, and the inspection of boilers and machinery not intended for classification, it will be seen that the Society has plenty of responsibility and work upon its hands. To all this the Committee have now added the periodical issue of the *Universal Register* with its enormous mass of data, of which the tables before us are merely extracts. Whether or not success attends them in their new enterprise, they have at least deserved it. The work is all it professes to be, and we heartily commend it to our readers both for purposes of reference and study.

THE ROYAL AGRICULTURAL SOCIETY'S SHOW.

THE Royal Agricultural Society's Show is being held this year at Newcastle-on-Tyne. The situation selected on Gosforth Moor leaves nothing to be desired. The ground is high and dry, and the soil light. Easy access is obtained to it by a good tram-car service. The grounds of the Exhibition abut on the showyard; and it is to be presumed that a gateway will be opened between the two. Nothing of the kind has, however, any existence as yet. In the implement yard little or nothing is yet to be seen. Machinery is arriving daily in considerable quantities. It is worth notice that an entirely new set of entrance buildings has been provided of excellent design, the production of Mr. Benison, the architect to the Society.

The present show possesses unusual interest for engineers, because competitive trials of steam engines are being carried out for the first time since the memorable trials took place at Cardiff in 1872. Those makers who had already obtained well-earned prizes and medals, held that they had done quite enough for the improvement of the portable and traction engine in the matter of economy of fuel. But younger firms held, not unnaturally, a different opinion They did not admit that finality had been reached by Messrs. Clayton and Shuttleworth and the Reading Ironworks Company at Cardiff; and pertenaciously asked that more trials should be carried out. The Royal Agricultural Society refused to do this. It is unnecessary to recapitulate a well-known story. The Royal Agricultural Society at length gave way, and announced that this year prizes would be awarded, the competitive engines to be divided into two classes, the first being an "agricultural locomotive engine on the compound principle, not exceeding 8-horse power, and not more than 10 tons weight empty—£200;" the second-class being "agricultural locomotive engine on the simple principle, not exceeding 8-horse power, and not more than 10 tons weight empty—£100." The word "locomotive" as used here does not mean that the engine should of necessity be self-propelling, but only that it should be portable. Subsequent to the publication of the Society's announcement, the principal makers issued a species of circular-letter in which they declared that they could take no part in the proposed competition, because trade was too bad, and the time available for producing a really economical engine was too short. However, there are firms quite as capable of designing and building excellent engines as any of those which have refused to compete, and instead of the competition ending, as was perhaps expected, in a *fiasco*, no fewer than eleven engines have appeared at Newcastle, as against twelve at Cardiff, and the trial promises to be in all respects at least as interesting as that which was carried out in 1872. It is by no means impossible that had those who signed the circular-letter to which we have referred known what would really take place, the letter would never have been written. One and all of these firms claim that their present engines beat in economy of fuel the best that was achieved at Cardiff. They do not appear, however, to have the courage of their convictions. In the first place, if their engines are already so excellent, they could not have wanted six or twelve months to produce something worthy of being sent to the brake, and in the second place, it does not redound to their credit that they have declined to submit their engines to a public and impartial test. The argument based on lack of time has had small weight, for most of the engines sent for trial at Newcastle have been designed and built within the last few weeks, and have scarcely had steam in them before reaching the trial yard.

The trials are being carried out by Sir F. Bramwell, and Mr. W. Anderson, assisted by Mr. Courtenay. Only two engines can be run on the brake at one time, as a large staff of assistants is needed to take and record observations. Lots were cast, therefore, to settle the order of the trial, and we give the names of the competitors in this order. The simple engines are to be tried first, as follows:—The Alnwick Engine Company, Messrs. Davey, Paxman and Co., E. Humphries, Jeffrey and Blackstone, W. and H. M'Laren, E. Foden and Sons. The compound engines are by T. Cooper, Davey, Paxman and Co., E. Humphries, Foden and Sons, and W. and H. M'Laren. We have already published the instructions for trial issued by the Society. It will be enough to say here that each engine will make a preliminary run, which is a departure from past practice, and that instead of, as formerly, allowing 14 lb. of coal per declared horse-power, and judging merit by the time which the engine could run on that weight, the duration of each run will now be limited to four hours, the coal burned during that period being weighed. The change was essential, because whereas the best run made at Cardiff lasted 4 hours 54 min., it is highly probable that some of the compound engines at Newcastle could run under similar conditions over seven hours, corresponding to a consumption of under 2 lb. per horse per hour. This would drag out the trials to an inordinate degree. Even as it is, it is unlikely that they will terminate until the middle of next week.

It is of course impossible while the trials are yet in progress to give any particulars of the results so far obtained. The bare figures unreduced would prove of little value; and their publication might convey an entirely erroneous impression concerning the relative merits of the various engines. We shall therefore do no more now than give a general idea of the nature of the various competing engines, and for this purpose we shall take them in the order of trial.

The Alnwick Foundry Company's engine is the first the company has built. It is a curious fact that new firms almost invariably resort to old types of engine, and the particular engine exhibited is a very ordinary specimen of the agricultural engine of, say, twenty years ago. It is in no sense or way a racer. The only particularity about it is that the cylinder, which is 8¾in. diameter by 12in. stroke, is secured to the top of the boiler by angle irons, which makes a very good job. There is only one simple slide valve, no cut-off gear of any kind. The pressure is 75 lb., and the boiler is fed by a No. 4 injector.

Messrs. Davey, Paxman, and Co.'s engine is of the usual type of portable made by the firm, with a jacketted cylinder 9½in. diameter and 12in. stroke. The speed is controlled by Paxman's well-known automatic governor cut-off gear. The pressure is 100 lb.

Messrs. Humphries' engine has a cylinder 10·5in. diameter, 14in. stroke. The speed is controlled by a Hartnell governor on the crank shaft. The working pressure is 80 lb.

Messrs. Jeffrey and Blackstone's is a little vertical engine mounted on wheels and shafts, and known as "The Viator."

Messrs. McLaren's engine is of the ordinary portable type. The cylinder is 8½in. in diameter, 15in. stroke. The speed controlled by a Hartnell governor on the crank shaft.

Mr. Foden's engine is a traction engine, with a cylinder 7½in. diameter and 10in. stroke, working at 120 lb., the speed being controlled by a novel and ingenious cut-off gear, recently patented by Mr. Foden, which could not be made intelligible without drawings, which we may supply later.

The first compound on the list is a traction engine sent by Mr. Cooper, but built to his order and design by Messrs. Richard Garrett and Sons, who have, however, nothing whatever to do with sending it for trial. This engine is of peculiar construction, and we must reserve a description of it, however brief.

Messrs. Davey, Paxman and Co.'s engine has cylinders 5·75in. + 9·25in. × 14in. The speed is controlled by a Paxman governor. The pressure is 140 lb.

Messrs. Humphries' engine is peculiar in having the cranks set at 180 deg. The cylinders are 7in. + 12in. × 14in. It is of the ordinary portable type, and fitted with a Hartnell governor.

Messrs. Foden's is a traction engine with cylinders 4·75in. + 9·5in. × 10in. The working pressure is 250 lb., and a great deal of interest centres in its performance, as this will be the first time, we believe, that any public test has taken place of an engine working at such a pressure, if we except one carried out some years ago by Sir F. Bramwell with a Perkins' engine.

The last engine on the list is Messrs. McLaren's, a portable engine with cylinders 5·75in. + 9in. × 15in., controlled by a Hartnell governor on the crank shaft.

Many of these engines are provided with dainty devices for economising fuel, and bear very high testimony to the skill and ingenuity of men not over burthened with mathematical knowledge, which last, we may add, has hitherto failed to produce any wonderful departure in steam engineering or a single noteworthy success.

THE INSTITUTION OF CIVIL ENGINEERS.—It was last week judicially decided that the Institution is liable, under the "Customs and Inland Revenue Act, 1885," to pay the tax of 5 per cent. on its annual income in lieu of probate and other duties. It was argued that the Institution fell within the exemption contained in Section 3 in favour of property applied for "promotion of education, literature, science, or the fine arts," but it was held that the exemption had relation to general education, and not to the promotion of skill in any one branch of science or art for the professional gain of the members of any particular body. It was pointed out during argument that the Inns of Court were liable to and paid the tax.

FLEUSS' PATENT HAND ICE-MAKING MACHINE.

IN an ice-making machine for domestic purposes the three qualifications of portability, rapidity and certainty of action, and cleanliness, are essential. The machines herewith illustrated are designed to combine these qualifications, while at the same time they are easy of manipulation, and the production of ice by them entails but little labour. At present, machines are made in two sizes, the smaller one being represented in elevation by Fig. 1, while Fig. 2 shows the larger size partly in elevation and partly in section, Fig. 3 illustrating the air-pump, common to both machines, in sectional elevation. From Fig. 2 it will be seen that the machine has a stoneware vessel, or absorber, E, to contain sulphuric acid. This is thickly covered with a compo-

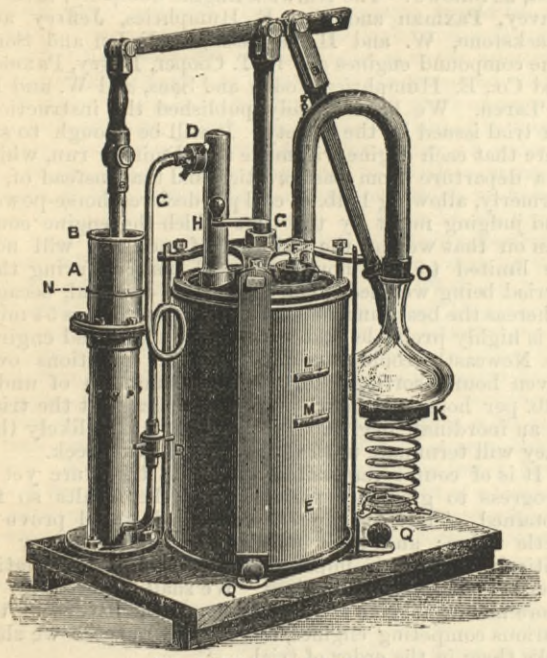


Fig. 1—SMALL MACHINE.

sition, made from paraffin and resin, to prevent the passage of any air through the pores—which was found to occur in the early machines—and the whole is then enclosed in an outer metal case, as shown in Fig. 1. The lid J of this vessel is of lead, and has an angle-iron *e* around its outer edge. Above the lid is an iron ring *f* with radiating arms. The absorber stands on another iron ring *g*, the whole being mounted on a suitable base

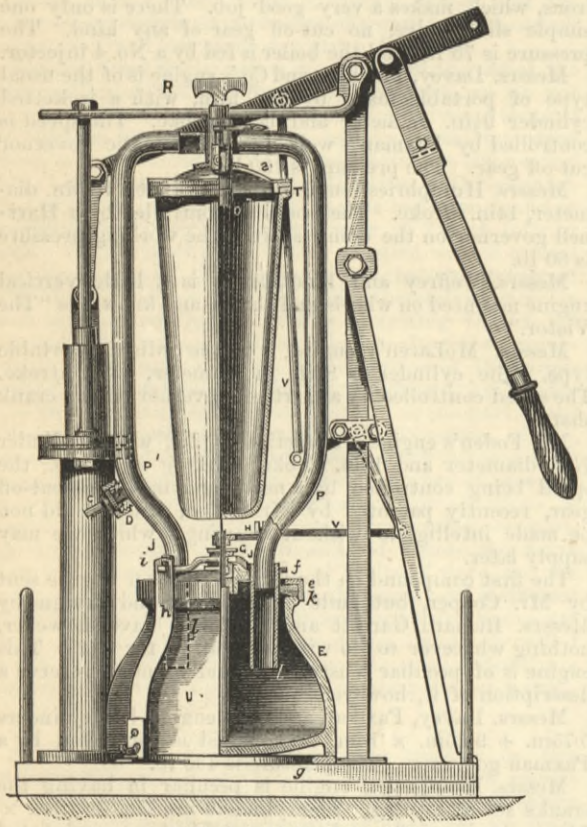
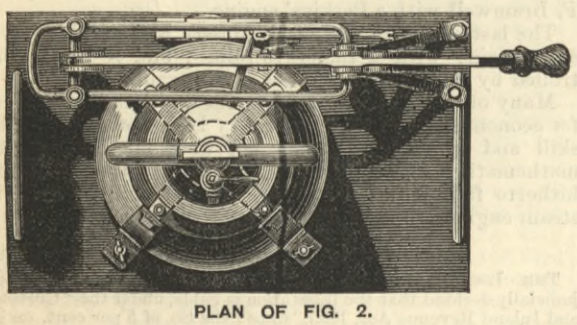


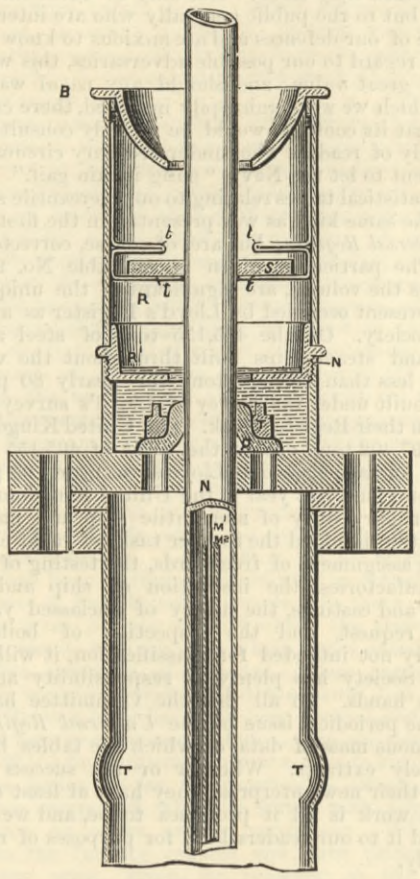
Fig. 2—LARGE MACHINE.

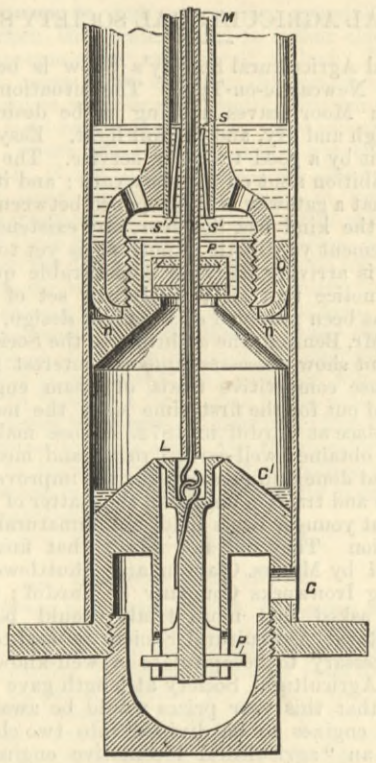
from which iron straps *h* are carried upward. The straps *h* are provided with slots at their upper ends, through which the ends of the iron arms pass, as at *i*, and are held down by the thumb-nuts Q, while the screws *j* bear upon the ring *e*, and so serve to jamb the lid down on the top of the absorber. To ensure a tight joint between the lid and the top of the absorber, a groove is



PLAN OF FIG. 2.

formed around the outer edge of the lid as shown at *k*. Into this an elastic ring is put, and as the thin tongue of lead is partly flattened on the application of pressure by the screws *j*, it follows that a liquid-tight joint is made thereby which the sulphuric acid cannot pass, while the elastic ring makes an air-tight joint around the outer circumference. In this way the elastic ring is protected from injury by the acid; and to still further ensure tightness, the top of the absorber and the underside of the elastic ring are painted over with paraffin, and then put together whilst warm. The absorber is provided with a funnel-like filling hole closed by a plug (not shown on Fig. 2, but corresponding with that marked F on Fig. 1), and the lid is formed with two sockets *l l*, into which the ends of the pipes P P^1 are soldered. These pass upwards, and carry a tap R. Extending from the tap is a domed disc S, which forms a lid or cover for the glass vessel containing the substance to be frozen, a ring of soft material at *r* ensuring a tight joint. A nozzle O allows of the neck of a flask being substituted for the larger vessel shown. The tap R controls the communication between the interior of the vessel and the pipe P leading to the absorber, the pipe P^1 being closed at the top and also at a point just above the entrance of the small suction





3—ENLARGED SECTIONAL ELEVATION OF AIR PUMP.

pipe C. The pipe P passes down to nearly the level of the acid in the absorber, so that all vapour may be brought into close proximity with the acid, and be rapidly absorbed thereby. The bell-crank lever T and links V V work the agitator blade of lead U, when the machine is in operation.

As this blade is mounted on a vertical spindle an ordinary stuffing-box G, out of the reach of the acid, suffices. If it is desired to introduce the liquid to be frozen in small quantities from a jar, or other receptacle, the small auxiliary tap X is used for the purpose, a piece of tubing serving to put it in communication with the jar. By this means layer after layer of water or other liquid can be frozen in less time than would suffice to freeze an equal quantity in bulk.

The machine shown in Fig. 1 differs from the one previously described in some respects. It is of smaller capacity, and in it the agitator is worked by the handle H from time to time as required, and not from the main handle. Normally the acid stands at the level M, and when, by absorption of the aqueous vapour, it reaches the level L, it must be replenished. Though shown with a flask attached, a disc, and auxiliary tap arrangement similar to S and X of Fig. 2, can be attached to the nozzle O. Approximately the larger machine will freeze a pint of water in two minutes, or it will reduce the temperature of a pint of water sufficiently low for ordinary drinking purposes in from forty to sixty seconds. The smaller machine has about half this capacity. In either machine one charge of acid serves for about 100 freezings.

The *modus operandi* and principles of construction of the air pump Fig. 3, will be best explained by considering one complete cycle of its action. Assuming the piston *n* to be on its down stroke, and the three-winged suction valve L to be closed as shown, the hollow cone forming the bottom of the piston fits accurately down on the cone of which the valve L is the apex, and forces all the air, and after it the oil in the annular gutter C^1, up through the valve P. Thus all air is effectually expelled from below the piston. The piston now commences its upstroke, drawn by the hollow piston rod N, and the suction valve is lifted by the hooked wire M^1 soldered to the tubular rod M at M^2. The lower end of the hollow piston rod N is provided with spring clips *s s*, which grip the rod M sufficiently to lift the suction valve during the upstroke of the piston, a cross pin P limiting the lift. At a point just before the piston reaches the top of its stroke, the clips *s s* pass beyond the top of the rod M, and the valve falls into its seat. At the same time that the valve falls, the cavities T T, formed in the pump cylinder, fill with some of the oil from above the piston, and on the still ascending piston uncovering these cavities the oil therein flows down into the gutter C^1, ready for the next downstroke. The piston now forces the oil above it, and with it all trace of air past the delivery valve Q, and the upstroke is thereby completed. The delivery valve Q also serves as a stuffing box, and thus not only reduces the friction on the piston-rod, but also does away with the necessity for accurate fitting that would otherwise exist. As will be seen, this valve consists of a disc of leather, formed as a hydraulic collar, and a metal ring T, the latter serves to retain the leather in shape, and also acts as a weight. An oil chamber R, surmounting the cylinder, ensures the delivery valve being always covered with oil; while the disc R^1 prevents the valve being lifted too high, and also checks the upward column of oil. To prevent any oil being splashed out at the top of the pump, the piston-rod is made to pass through a disc of leather S, placed between two stops *t t*, carried by the cover B, dished as shown to still further ensure that no oil shall be ejected from the chamber. The valve P consists of a leather disc surmounted by a recessed metallic piston carrying a second disc of leather. The piston *n* has a deep leather packing O, while the seat of the suction valve L is faced with kid, and as all these, together with the delivery valve, are constantly working in oil, it follows that friction is practically eliminated, and that great pliability of the various leathers, and consequent tightness throughout the pump, is obtained. With this pump a Torricellian vacuum can be obtained, and maintained without any further operation of the pump for a lengthened period of time. The machines can be seen in operation at the American Exhibition, Earl's Court.

NEW GREASE-CUP LUBRICATOR.

THE use of grease, more especially in a form similar to vaseline, is much extending, and various forms of lubricating grease-cups have been brought out for using it. That illustrated is a new form now being introduced into this country by Messrs. Seck Brothers.

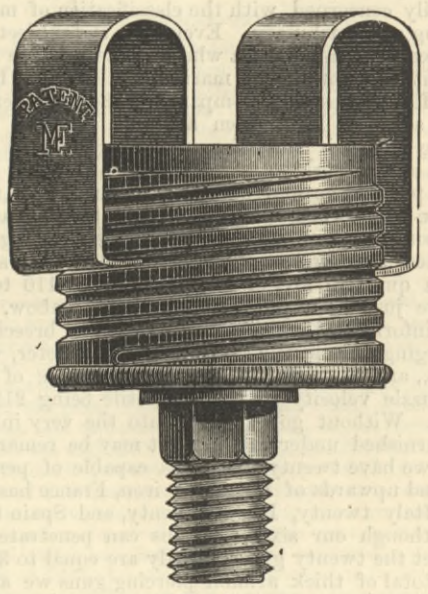


Fig. 1

The outside of the cup is screwed—see Fig. 1—and a spring clip takes into the thread on the opposite ends of a diameter. The clip carries a piston which bears upon the grease, and forces under spring pressure a quantity of it from the cup into the

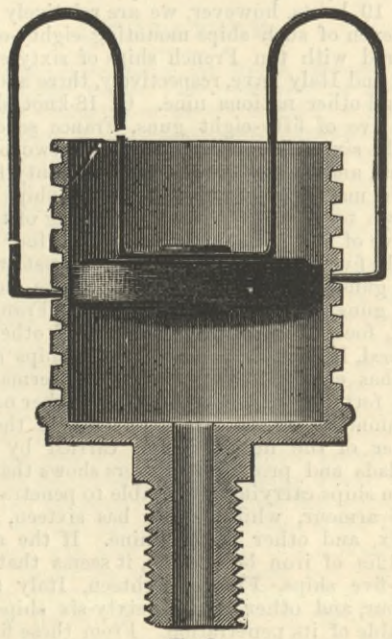


Fig 2

bearing when the clip is turned. The use of the spring clip secures a small amount of elastic pressure, which remains effective after the clip has been turned, the pressure upon the piston being thus extended over a considerable period of time, and making the extrusion of the grease a gradual process.

NUT-FINISHING MACHINE, MANCHESTER EXHIBITION.

MESSRS. DUNDERDALE WOOD AND CO. ENGINEERS

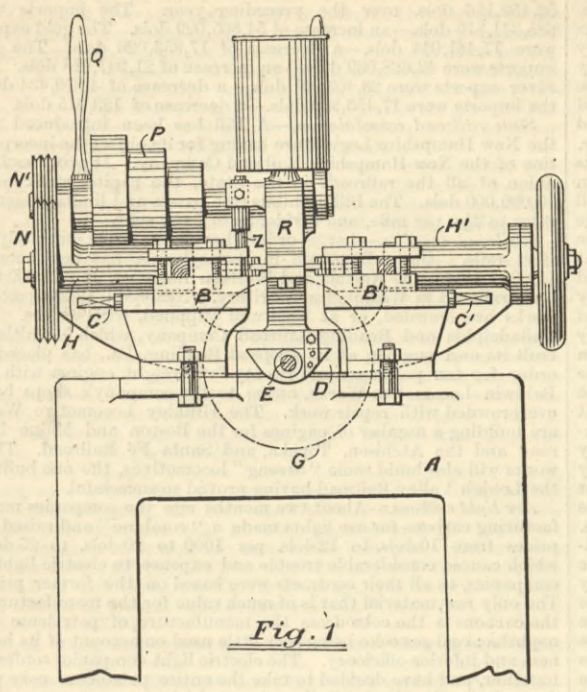


Fig. 1

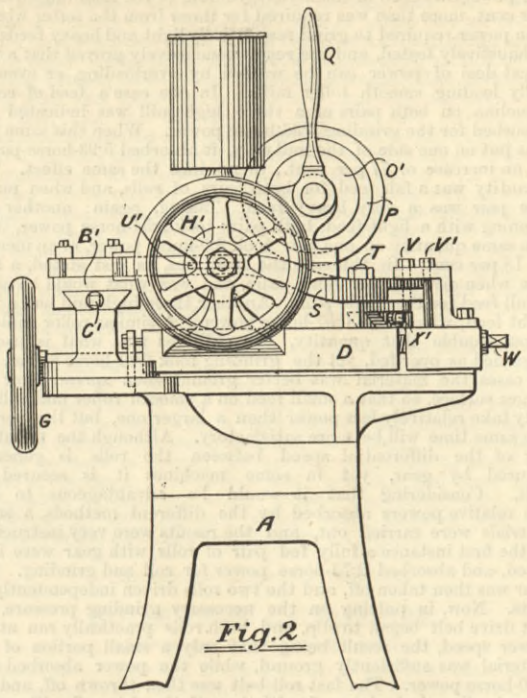


Fig. 2

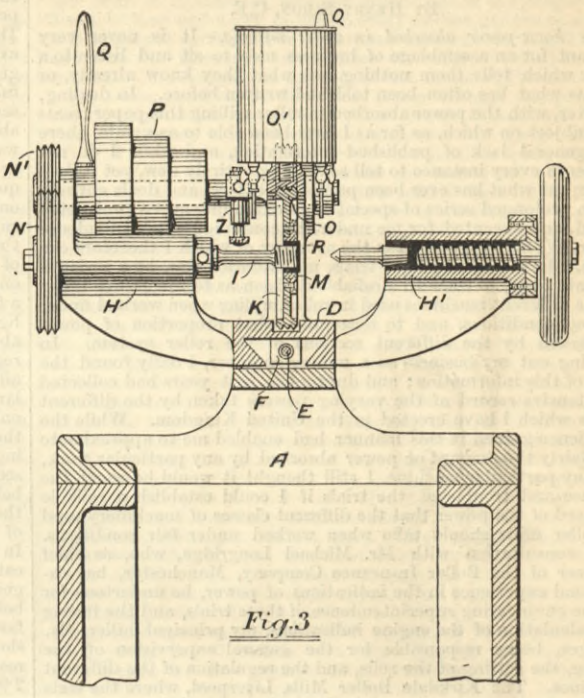


Fig. 3

WOOD'S NUT-FINISHING MACHINES.

THE accompanying engravings illustrate machinery for facing and chamfering screw nuts on each side of the nut without re-chucking. It is exhibited at Manchester by Messrs. Dunderdale, Wood, and Co. Fig. 1 is a front view, Fig. 2 is an end view, Fig. 3 is a front view partly in section, Fig. 4 is a transverse section, and Fig. 5 is a plan. In each of the figures similar letters are employed to denote similar parts.

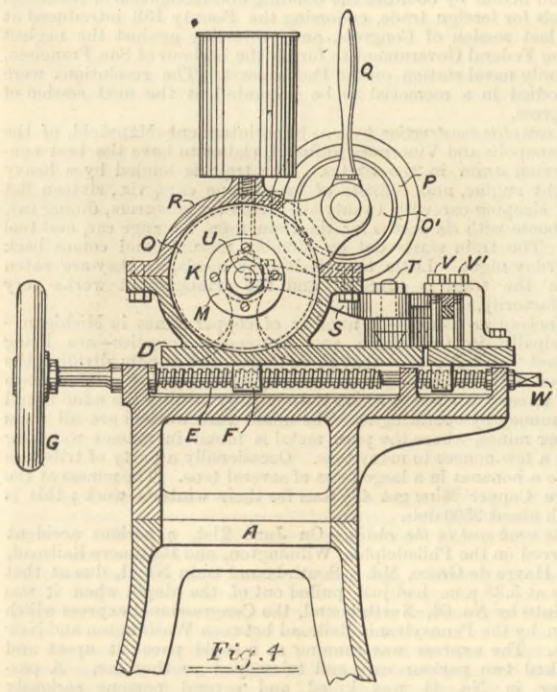


Fig. 4

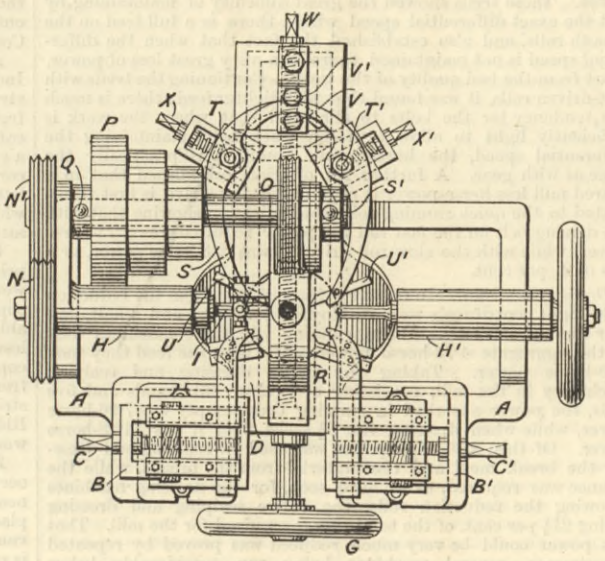


Fig. 5

A is the support or underframing; B B^1 are slide rests, the slides of which are adjusted by screws having squares C C^1 formed upon their ends; D is a transverse slide, operated by the screw E, which works in the nut F, attached to the transverse slide; G is a handle for actuating the screw E; H H^1 are two headstocks practically equivalent to the headstocks of an ordinary lathe; I is a mandrel, having a screwed head of larger diameter than the stem of the mandrel; this mandrel has its head screwed to correspond and fit within the particular size of nut to be operated on, and the screwed part is a little shorter than the depth of the nut; K is a disc, having a central perforation corresponding to the dimensions and shape of the nut. As represented in the drawings Figs. 3 and 4, the nut L is carried in a chuck bush M. This arrangement obviates a change of the disc K when the size of the nut is altered. The disc K is concentric with the mandrel, and is rotated at an equal rate by means of the two pairs of friction pulleys N N^1 and O O^1, N being equal to O and N^1 to O^1. The friction pulleys are driven from the cone pulley P, and are put in gear by means of the handle Q, which is connected with an excentric. S S^1 are two curved or bent levers or tool carriers. Each tool carrier is pivotted at T T^1 to a pivot carried by the traversing slide D; their inner ends carry the chamfering tools U U^1, and their outer ends are controlled by two stationary bowls V V^1, the position of which may be adjusted by the screw W.

In working the machines a mandrel I of the required size is fixed in position; the various cutting tools are changed, altered, or adjusted so as to produce their respective cuts on the nut to bring it to the desired form and dimensions; the adjusting stop or bowl Z is secured in its proper position, and a suitable bush or chuck for holding the nut is secured in the disc. The friction pulleys being out of gear, the apparatus may be set in motion, when the mandrel will revolve and the disc will remain stationary. A black screwed nut may now be presented to the head of the mandrel through the opening in the centre of the disc, when the screwed part of the mandrel will engage with the thread of the nut, which is prevented from rotating by being held within the stationary disc. The nut will consequently be screwed upon the head of the mandrel until it comes in contact with the adjustable stop Z. The friction pulleys are then put into gear by the handle Q, whereupon the mandrel with the nut and the disc with the nut therein are driven at the same speed. The handle upon the screw actuating the traversing slide is then rotated so as to bring the surfacing and levelling tools into operation upon the nut. At the same time, the centres of the curved or bent tool carriers S S^1 being moved with the traversing slide and the tails of the tool carriers being prevented from partaking in the transverse motion by the stationary studs or bowls V V^1, the tool ends of the carriers swing through the arcs of circles around T T^1 until their cutting tools come into contact with, and chamfer each end of, the bore of the nut. When the cuts are completed the motion of the hand wheel, and consequently of the traversing slide, is reversed, and the tools are thereby removed so as to permit the withdrawal of the nut.

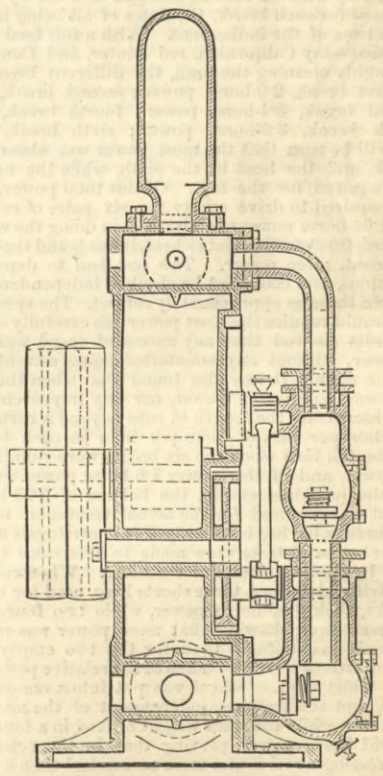
THE WEARDALE RAILWAY.

A DEPUTATION from Weardale has pressed on the attention of the North-Eastern Railway directors the need that there is for the extension of the present line of railway further up the dale, and the question is still under the consideration of the board. The present terminus of the line is at Stanhope, a little beyond some of the quarries which yield so much of the limestone for the Cleveland iron furnaces. For some miles up the dale there are no engineering difficulties of moment, and it is this part of the district through which it is now proposed that the railway should be made. A survey was completed some little time ago, and the deputation presented the result. The estimated cost of the extension is £48,627, and there was an estimate of the traffic which seemed to show that there would be a yield enough to pay expenses and leave 4 per cent. on the capital. Weardale, as is well known, is rich in minerals, but there is far from being a demand sufficient to develope them now. The lead mines were worked for centuries, and they still yield large quantities, which would in all probability be increased if the lead could be placed cheaper in the market, as would be the case with cheaper transit. There is a rich iron ore also found, but it is only slightly worked, and the possibilities of its further utilisation depend chiefly upon the greater possibilities of the demand for iron and steel. Apart from these, the demand for railway service would be mainly for the agricultural industries and those dependent thereon, and these industries are now greatly depressed. It follows, therefore, that as the present position of the Dale's industries is one of general dulness, any great change in the future is more likely to be on the side of improved traffic, and thus a reliable estimate now is not likely to be above the yield of the future. But the question is one of a twofold character, and there is the fact that if the yield were likely to be much greater, the railway company would have needed no pressure to induce it to make the line. One of the chief factors of the position is that the agricultural industries do not as yet show any signs of recovery, and though the gradual reductions of rent will tend in that direction, yet the cheaper production of food abroad will keep down the range of agricultural prices for long. Increased facility for cheaper transit would, of course, benefit the agriculturists greatly; and probably the knowledge of this fact is at the back of agitations such as that we are referring to. But the farming class will have to help themselves. The railway shareholders will only make such lines as are profitable investments as railways; and if railways are to be made which will be on the whole profitable, but mainly profitable to the districts and the industries which are to be served, then the conclusion will be that these districts and these industries will have to furnish a large portion of the capital required. If the fact were generally recognised, we should find a much more rapid construction of railways in districts needing them for their industries. In the case of Weardale, for instance, one of the great owners of property is that wealthy body, the Ecclesiastical Commissioners. There is it is urged, no reason why it should not advance a large portion of the sum needed to make the line. It would be an investment. it is said, for it sounder than many, helpful to its landed and mineral properties, and one which might perhaps be safer in the present temper of the nation than that of land to such bodies; and it would make more profitable the industries on which a large part of its property depends in Weardale.

DIFFERENTIAL FEED AND FORCE PUMP.

IT is said the differential feed and force pump illustrated herewith is designed to overcome difficulties in boiler feed pumps driven by power. Among the advantages claimed are the following: The passage of water through the pump is not obstructed by corners and short angles to be turned, but is in a straight, continuous line from the time it enters till it leaves the pump.

The two plungers being directly in line, one over the other, and the motion from the driving gear and connecting rod being guided by a slot placed in the columnar base of the pump, there can, consequently, be no side wear in the stuffing glands of either plunger, and they can be kept tight, while wearing much



longer than any others yet used. These pumps, having three suction inlets and three discharge outlets leading from chambers cast in their base, enable the piping to be taken off in the most convenient manner, and with the least number of elbows, and admits the attaching of a return connection pipe and valve from the discharge to the suction chamber; thus the discharge of the pump may be regulated without altering its speed.

Air entering the pump from the suction or elsewhere must pass up through the plungers and find its way into the air chamber, which is the highest part of the pump, and from which the air is continually absorbed by the water. The driving mechanism is all outside the pump. This is an American invention.

RECORDS OF TESTS AS TO THE POWER CONSUMED BY VARIOUS MACHINES USED IN ROLLER MILLS.[1]

By Henry Simon, C.E.

The horse-power absorbed in roller milling.—It is never very pleasant for an assemblage of business men to sit and listen to a paper which tells them nothing but what they know already, or repeats what has often been told and written before. In dealing, however, with the power absorbed in roller milling this paper treats of a subject on which, as far as I have been able to ascertain, there is a general lack of published information, and while I do not profess in every instance to tell something entirely new, yet it does not repeat what has ever been published before, and deals entirely with a prolonged series of special trials extending over a protracted period, and executed for me under the continued superintendence of Mr. W. Stringer, and for the accuracy of which I therefore can vouch. In instituting these trials, my intention was, by a series of accurate tests, to come to a reliable decision as to the power taken by the different machines used in roller milling when worked under varying conditions, and to determine what proportion of power was taken by the different sections of the roller system. In carrying out my business as a milling engineer, I daily found the want of this information; and during the past years had collected an extensive record of the varying powers taken by the different plants which I have erected in the United Kingdom. While the experience gained in this manner had enabled me to approximate very fairly the amount of power absorbed by any particular work, and any particular machine, I still thought it would be worth the expense and trouble of the trials if I could establish a reliable standard of the power that the different classes of machinery used in roller mills should take when worked under fair conditions. After consultation with Mr. Michael Longridge, who, as chief engineer of the Boiler Insurance Company, Manchester, has exceptional experience in the indications of power, he undertook for me the engineering superintendence of these trials, and the taking and calculation of the engine indications, my principal miller, Mr. Stringer, being responsible for the general supervision of the milling, the setting of the rolls, and the regulation of the different machines. The Kirkdale Roller Mills, Liverpool, where the tests were made, is a compact, well-built, six-floored building, five floors of which are partially occupied by the roller mill. It is a first-class eight-sack plant on my system, and having plenty of room and light, was for this reason a place particularly suitable for the trials, which were carried out by one double-cylinder high-pressure engine, with cylinders 16⅞in. diameter and stroke 2ft. 9in., driving the whole plant, and a small 8⅜in. diameter single-cylinder engine, 14in. stroke, which was placed on one of the mill floors, and to which the different machines, the powers of which were to be ascertained, were consecutively connected. The smaller engine was very sensitive, and capable of showing the slightest variation in power. During the trials indications were taken with the main engine, while the mill was running under very varying conditions, on a variety of wheats, with large and small feeds and at different speeds. With the large engine the mill was also indicated in sections, and the power consumed by each section was again and again checked, machine by machine, by means of the smaller engine, with which were also tested independently the elevators, worms, &c. Indications were taken of the same machines under varying conditions as to pressure used in grinding, speeds, &c., and a sufficient number of diagrams were taken to guard against error, in many cases several days having been spent over one series of indications in order that a thoroughly reliable result might be arrived at. All indications, whether with the larger or smaller engine, were, whenever practicable, checked independently, and every precaution taken that the results obtained should be not only approximately, but, as far as possible, absolutely correct. It would be impossible, in the limits of a short paper, to go into the details of those trials, though to many the particulars would be interesting, but as the taking of the indications, with the preparations for them, and the necessary calculations afterwards was the work of months, it will be seen that only a very condensed summary of the results can now be brought before you.

Granulation.—I shall first deal with the granulation, giving only such results as I think would be interesting to the general miller, omitting small fractions, except where the smallness of the total consumed power makes them absolutely necessary. The quantity of wheat that was on the mill during the trials of course varied from day to day. In order to simplify the figures, I have by calculation averaged the work to 8½ sacks—of 280 lb.—finished flour per hour, and the results given are based on this quantity. The mill was fitted up with six breaks, one pair of 24in. by 10in. fluted rolls being used for each break, the flutes of all being in good condition at the time of the indications. With a full feed of medium condition wheat—say Californian, red winter, and Canadian—and when thoroughly cleaning the bran, the different breaks took as follows:—First break, 2·0-horse power; second break, 4·12-horse power; third break, 3·4-horse power; fourth break, 3·45-horse power; fifth break, 3·0-horse power; sixth break, 1·32-horse power. It will be seen that the most power was absorbed by the second break, and the least by the sixth, while the next smaller power was required for the first. Of this total power, 3·30-horse power was required to drive empty the six pairs of rolls, and the balance of 14·04-horse power was absorbed in doing the work. With the mill on hard-frosted Minnesota wheat, it was found that the breaks took 21 per cent. more power. This test had to depend on one set of indications, and could not be checked independently, so that I can only give these as approximately correct. The speed at which a break roll would require the least power was carefully ascertained, and the results showed that any excess of speed was a distinct waste of power, without any counterbalancing advantage in the quality of the work. It was also found that when the rolls were sharp there was no gain in power, nor any improvement in the material, by increasing the length of rolls beyond a certain number of lineal inches per sack of flour per hour on each break. The scalping of the full feed when the six breaks were running required 4·93-horse power, and of this power 1·6-horse power was absorbed in running the machines empty, the balance of 3·33-horse power being all that was required for the actual treatment of the feed. Some of the breaks having been scalped in centrifugals and some in reels, another series of tests were made to determine the relative power taken by the two classes of machines. When running idle, a double centrifugal scalper, three sheets long, used for the scalping of two breaks, took 0·55-horse power, while two four-sheet reels took 0·38-horse power, showing that more power was required for the empty double centrifugal than for the two empty reels. A number of indications were also taken of the relative power absorbed in scalping. Thirty cwt. of wheat was put into a one-sheet centrifugal scalper, and the scalping, independent of the machine, took 0·82-horse power, while the same weight of feed in a four-sheet reel only took 0·51-horse power, proving that in the actual work of scalping or dressing a reel is also more economical than a centrifugal scalper.

Smooth rolls.—In the mill were four sets of 20in. by 10in., and three sets of 20in. by 9in. three-high smooth roller mills. These were found to take in the aggregate 22·49-horse power, or 2·64 per sack of flour, and when running empty, 7·52-horse power. Two 20in. by 10in. mills took all the first-class semolina and absorbed 6·74-horse power. One similar set of rolls and one set of 20in. by 9in. took all the fine middlings and absorbed 5·46-horse power, while one set of 20in. by 10in., and two sets of 20in. by 9in. took the returns from the first centrifugals and all the second-class material and tails and absorbed 10·26-horse power. A trial of hard-frosted Minnesota wheat showed the smooth rolls taking 4·70-horse power per sack of flour, while a similar quantity of medium wheat only took 2·91-horse power. This was an increase of 78 per cent. The actual increase of pressure on the smooth rolls, however, was very much greater, for if we deduct the power required to drive the empty rolls, which was the same with both wheats, the power absorbed in the actual grinding of the middlings was 112 per cent. more than was required for those from the softer wheats. The power required to grind respectively light and heavy feeds was exhaustively tested, and the result conclusively proved that a very great deal of power can be wasted by overloading, or even by fully loading smooth roller mills. In one case a feed of coarse semolina on both pairs of a three high mill was indicated and absorbed for the grinding 3·36-horse power. When this same feed was put on one side of the mill only, it absorbed 5·93-horse-power, or an increase of 77 per cent., to produce the same effect. This quantity was a fair feed for both pairs of rolls, and when put on one pair was a very heavy feed. Taking, again another mill running with a light feed, both pairs took 2·54-horse power, while the same quantity on one pair took 3·0-horse power, or an increase of 18 per cent. In this case the feed was, as just stated, a light one when divided over both pairs, and was what would be called a full feed for the single pair. Another three-high mill had a very light feed, which took 0·57-horse power. A similar roller mill had about double that quantity, but still was not what is usually regarded as over fed, yet the grinding took 2·81-horse power. In all cases the material was better ground when spread over the larger surface, so that a small feed on a smooth roller mill will not only take relatively less power than a larger one, but the work at the same time will be more satisfactory. Although the maintaining of the differential speed between the rolls is generally secured by gear, yet in some machines it is secured by belt. Considering that it would be advantageous to test the relative powers absorbed by the different methods, a series of trials were carried out, and the results were very instructive. In the first instance a fully fed pair of rolls with gear were indicated, and absorbed 2·73-horse power for roll and grinding. The gear was then taken off, and the two rolls driven independently by belts. Now, in putting on the necessary grinding pressure, the fast drive belt began to slip, and both rolls practically ran at the slower speed, the result being that only a small portion of the material was sufficiently ground, while the power absorbed was 2·90-horse power. The fast roll belt was then thrown off, and the second roll entirely driven by friction off the slow roll. The relief given by throwing off the slipping belt enabled the same amount of work to be done with 20 per cent. less power, the roll now working with 2·32-horse power instead of 2·9-horse power. A stronger belt was then put on the fast roll, and immediately the slow roll belt began to slip, and both rolls ran at the quicker speed. The quality of work was the same, while the power taken was increased to 5·63-horse power. The slow roll belt was next thrown off, and the springs of the rollers were tightened, so as to put an increased pressure on the material, but the work was still as unsatisfactory, the middlings being only partially reduced, while 7·6-horse power was absorbed. Both belts were next strengthened, and with some difficulty tightened sufficiently to maintain the differential speed without slipping. The middlings were now ground sufficiently, but the power absorbed was 5·15-horse power, while with the gear for exactly the same amount of material it had only been 2·73-horse power. These trials showed the great difficulty of maintaining by belt the exact differential speed where there is a full feed on the smooth rolls, and also established the fact that when the differential speed is not maintained there is a very great loss of power, apart from the bad quality of the work. Continuing the trials with belt-driven rolls, it was found that with lighter feeds there is much less tendency for the belts to slip, and that where the work is sufficiently light to allow of fairly slack belts maintaining the differential speed, the horse-power absorbed is practically the same as with gear. A further set of trials established that in a geared mill less horse-power is required if the drive is first transmitted to the quick-running roll, the indication showing that with the driving belt on the fast roll the power required was 2·73-horse power, while with the slow roll drive it was 2·8-horse power, or a loss of 2½ per cent.

Dressing machines.—In dressing the material from the reduction rolls, eight centrifugals were employed—four two and a-half, and four three sheets long. When running idle these machines took in the aggregate 4·73-horse power, while with the feed they took 5·98-horse power. Taking the entire dressing and scalping machinery in the mill, consisting of twelve centrifugals and five reels, the power absorbed in running them empty was 7·96-horse power, while when dressing the 8½ sacks flour it was 14·28-horse power. Of this, 8·30-horse power was used for scalping and dressing the break meal and the material from the breaks, while the balance was required, as we have seen, for the dressing machines following the reduction rolls, the entire scalping and dressing taking 21½ per cent. of the total power required for the mill. That this power could be very much reduced was proved by repeated experiments, several machines being run considerably below their normal speeds, resulting in every case in very much less horse-power being required to do the same amount of work. In one case a particular machine, which had on it a very large feed, when running at 200 revolutions, absorbed 1·43-horse power for the machine and work, while the same machine at 160 revolutions only took 1·07-horse power, being a saving of power of 25 per cent. Again, a centrifugal, scalping one of the breaks, took at 200 revolutions 1·56, while at 130 revolutions it only absorbed 1·15-horse power, being a saving of 26 per cent. In both these cases the work at the slower speed was as well done as at the 200 revolutions. On the further test of the power, taken by one of my 3-metre centrifugals, the average for a single machine running empty at 200 revolutions was found to be 0·71-horse power, which was divided amongst the several parts as follows:—The centre, shaft, and beaters took 0·51-horse power; the outside cylinder and rails carrying the silk, 0·12-horse power; and the collecting worm, 0·08-horse power.

Purification.—All the machines for purification in this mill absorbed only the small power of 4·66-horse power. Three semolina purifiers ran at 450 revolutions, and their fans at 900 revolutions. Under the purifiers were nine collecting worms, driven with cross-shaft and bevel gear. The three purifiers, fans, collecting worms, &c., only absorbed 2·55-horse power, or 0·85-horse power per machine. A "Reform" purifier, running at 450 revolutions, fitted with filter and a quick-running fan, took only 1-horse power. Two tailing sieves, an exhaust fan, and a dust catcher, absorbed only 1·11-horse power. From the small amount of power which is taken by the running of properly constructed purifiers, &c., it can be clearly seen that the better class of mill plants should require less horse-power per sack of flour manufactured than an inferior system. There are no other class of machines that with such little power will separate the injurious material and send it direct to the offal sack. The rejecting of similar material, in the absence of purifiers, by smooth rolls and centrifugals, &c., in addition to injuring the quality of the flour, must, and decidedly does, take considerably increased power. There were in this mill sixteen elevators running from the top of the mill to the bottom, each 48ft. high. They were all fair-sized elevators, with 4½in. cans and 5½in. webbing; but the whole power required to drive them at their full speed, empty, was only 0·65-horse power, while when the full feed was on the mill, the additional power absorbed was only 0·69-horse power, the whole power required for the elevators at their full speed being 1·34-horse power. To convey the material from the smooth rolls to the elevators, and collect the flour and offals, 316ft. of worming was employed, which, running empty, absorbed 1·64-horse power; with the full feed on, the additional power required was only 0·48-horse power. A special test of a large 9in. worm, carrying twenty-four sacks of flour per hour 47ft., only absorbed 6·58-horse per worm and feed.

(To be continued.)

[1] Paper read at the Millers' Convention.

AMERICAN ENGINEERING NEWS.

(From a Correspondent.)

Revenue statistics.—For the twelve months ending May 31st the exports of merchandise were 724,559,702 dols.—an increase of 52,459,156 dols. over the preceding year. The imports were 685,341,819 dols.—an increase of 54,805,029 dols. The gold exports were 17,461,014 dols.—a decrease of 17,853,026 dols. The gold imports were 42,668,039 dols.—an increase of 21,947,618 dols. The silver exports were 26,403,001 dols.—a decrease of 4,870,434 dols.; the imports were 17,453,900 dols.—a decrease of 123,915 dols.

State railroad consolidation.—A Bill has been introduced into the New Hampshire Legislature having for its object the incorporation of the New Hampshire Railroad Company. It provides for a union of all the railroads in the State, the capital stock to be 10,000,000 dols. The Bill prohibits free passes and limits passenger rates to 2½c. per mile, and dividends to 7 per cent.

Railroad supplies.—Large orders have been given out lately for steel rails. One rolling mill in Pennsylvania has contracts for 15,000 tons for the Norfolk and Western Railroad, and 15,000 tons for a railroad in Washington Territory. Nearly all the locomotive works are crowded, or at least well supplied, with orders. The Philadelphia and Reading Railroad Company, which has hitherto built its own engines, at its shops at Reading, Pa., has placed an order for ten passenger and twenty-five freight engines with the Baldwin Locomotive Works, owing to the company's shops being overcrowded with repair work. The Hinkley Locomotive Works are building a number of engines for the Boston and Maine Railroad and the Atchison, Topeka, and Santa Fé Railroad. These works will also build some "Strong" locomotives, the one built by the Lehigh Valley Railroad having proved so successful.

Arc light carbons.—About two months ago the companies manufacturing carbons for arc lights made a "combine" and raised the prices from 10 dols. to 12 dols. per 1000 to 20 dols. to 25 dols., which caused considerable trouble and expense to electric lighting companies, as all their contracts were based on the former prices. The only raw material that is of much value for the manufacture of the carbons is the coke from the manufacture of petroleum and naphtha; coal gas coke being very little used on account of its hardness and inferior efficiency. The electric light companies conferred together, and have decided to take the entire petroleum coke product of the Standard Oil Company—which is a great monopoly—and manufacture their own carbons, accepting the Standard Oil Company's figure of 160,000 dols. per annum for its entire yearly product of 20,000 tons. The factory will be established in New York. This deal effectually destroys the business of the carbon manufacturers, as the Electric Light Carbon Syndicate, while it will probably not use more than a third of the coke product, will control it all.

American shipping.—The Pacific Coast branch of the American Shipping and Industrial League, at a meeting in San Francisco, Cal., June 22nd, to consider remedies to prevent the decay of American shipping, adopted resolutions declaring that Congress should favour by bounties the building and navigation of American vessels for foreign trade, endorsing the Bounty Bill introduced at the last session of Congress, and protesting against the neglect of the Federal Government to fortify the harbour of San Francisco, the only naval station on the Pacific coast. The resolutions were embodied in a memorial to be presented at the next session of Congress.

A complete construction train.—Superintendent Mansfield, of the Indianapolis and Vincennes Railroad, claims to have the best construction train in the States. The train is hauled by a heavy freight engine, and consists of twenty-one cars, viz., sixteen flat cars, sleeping car with twenty-six berths for labourers, dining car, a caboose with six berths for the train men, baggage car, and tool car. The train starts out on Monday morning and comes back Saturday night. Little time is lost for meals, as they are eaten while the train is running, and the arrangement works very satisfactorily.

Working on shares.—A number of copper mines in Michigan—principally in Ontonagon and Keweenaw counties—are being worked "on tribute"—that is, on shares, the miners dividing the copper with the mineowners—and by this means the miners are able to earn fair wages where the company owning the mine would lose money by operating it. The mines thus worked are all mass copper mines, where the pure metal is found in masses weighing from a few ounces to many tons. Occasionally a party of tributers strike a bonanza in a large mass of several tons. The miners at the Ridge Copper Mine got 42½ tons for their winter's work; this is worth about 9500 dols.

The weak spot in the chain.—On June 21st, a serious accident occurred on the Philadelphia, Wilmington, and Baltimore Railroad, near Havre de Grace, Md. South-bound train No 41, due at that place at 5.38 p.m. had just pulled out of the depôt when it was run into by No. 66, North-bound, the Congressional express which is run by the Pennsylvania Railroad between Washington and New York. The express was running at a rapid pace; it upset and wrecked two parlour cars and telescoped another car. A passenger in No. 41 was killed and several persons seriously injured and scalded. The accident was the result of a combination of circumstances. The road is double tracked, but at this place there is a bridge only wide enough for a single track, and on this the two tracks overlap, there being still four rails; about 100 yards from the bridge the two tracks separate to the usual width apart. The switches are protected by signals, but there is no derailing device or safety siding. The South-bound train had the right of way and was protected by the signals, but the engineer of the express stated that he could not get his brakes to act. The engine of the South-bound train was clear of the switch, but the express struck the cars obliquely at the heel of the "Y." Such an arrangement of track should never have been permitted, especially where such fast traffic is operated, or it should at least have been protected by a derailing switch that, in the event of an engineer running past a danger signal, would turn the train into a blind siding. The weakest link in a chain determines its strength, and the single track link in a double track line determines the safety of the road.

The new war-ships.—The board appointed to select the most suitable designs for an armoured cruiser and an armoured battleship of 6000 tons each, from the competitive designs submitted to the Navy Department some time since, has approved the design for a battleship submitted by the Barrow Shipbuilding Company, of England, and reports that such a ship would be a valuable addition to the navy. No design was selected for a cruiser, and the plans prepared by the Bureau of Construction of the Navy Department will probably be adopted; the vessel will have a general resemblance to the Brazilian turret ship Riachuelo; it will be 310ft. long, 54ft. beam, 21ft. 6in. draught, 6600 displacement, 17 knots speed. There will be four 10in. guns in turrets *en echelon*, six 6in. guns, and thirteen rapid fire guns; there are also torpedo tubes for fish torpedoes and two steam torpedo boats. The armour belt is 17in. thick and 6ft. broad. The ship will be barque rigged.

The Vermillion iron range.—Capitalists are investigating the iron deposits of the Vermillion range in Minnesota, one of the richest on the Continent. The ores contain a remarkably small percentage of phosphorus, averaging ·055 per cent., while the metallic iron averages 65 per cent. Several companies have recently been organised, and the range will be developed.

The work of making new docks at Ardrossan, which will equal some of those on the Clyde, is in active progress, Mr. Lawson, of Glasgow, being the contractor. The old harbour has been piled in, and the water-tight sheathing attached to the piles. The docks will be about nine acres in extent. The products of the Lanarkshire coalfield, when the new line is completed, will be shipped at this port.

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

(*From our own Correspondent.*)

ON 'Change in Wolverhampton yesterday, and in Birmingham to-day—Thursday—there was a continuance of that forward movement which became noticeable last week. There seems to be an impression that the quarterly meetings will take a turn favourable to sellers. Consumers, therefore, are more disposed to enter into negotiations, but they are still unwilling to launch out much. Forward business has about it a little more freedom, with the result that some makers can look ahead with confidence.

The following circular has this week been issued by the New British Iron Company.—"In consequence of the more frequent requirements made of late for the supply of various sizes of iron and steel in very limited quantities, and the increasing costs occasioned thereby, notice is given that, in every case when less than 5 cwt. of any size is ordered, an addition of 10s. per ton will be made to the list price." This advance is not likely to affect the standard price. It is to provide compensation for the loss incurred by the frequent changing of the rolls.

The general basis will, it is anticipated, continue at the quarterly meetings next week, at £7 for bars, with 12s. 6d. extra for the Earl of Dudley's qualities. No intimation of an advance has been received from any of the leading makers, among whom are Messrs. William Barrows and Sons, Messrs. John Bradley and Co., the New British Iron Co., Messrs. John Bagnall and Co., and Messrs. Noah Hingley and Sons.

The list of Messrs. William Barrow and Sons is as here:—Bars, round, square, and flat, £7; best bars, suitable for chain-making and other purposes, £8 10s.; double best, suitable for superior chains, bars, and the like, £9 10s.; plating bars, £7 10s.; best angle, tee, and rivet iron £9; and double best, £10. Boiler plates the firm quote, £8 10s., £9 10s., £10 10s., and £14 10s., according to quality; and sheets, £8 10s. for 20 gauge, £10 for 24 gauge, and £11 10s. for 27 gauge. Hoops are quoted, £7 10s.; best, £9; and wide strips, £8 10s.

Stock-taking and repairs to canal basins are this week interfering with production at some of the works. At the same time the demand for urgent deliveries wears a favourable aspect. It is an indication that consumers are buying well within their requirements until they ascertain the turn which the quarterly gatherings may take.

Prices of ordinary bars keep at £5 10s.; common bars, £5; and hurdle sorts, £4 15s. Prices of hoops, £5 to £5 5s., and of gas-tube strip, £4 15s. to £5, though makers mostly quote £4 17s. 6d. Bedstead strip varies from £5 to £7, according to the nature of specification. Sheets are firmer, and orders are becoming so free that some makers consider themselves justified in demanding higher rates by 5s. per ton on forward business. The majority of the makers, however, while being firm in their prices, do not qnote any actual advance. Prices are £5 17s. 6d. for galvanising singles, £6 to £6 5s. for doubles, and £7 for lattens.

Sheets of the Woodford brand are named as £7 for singles, £8 10s. for doubles, and £10 for lattens. Crown Woodford qualities are £9 10s., £11, and £12 10s. respectively. Double best are £12 10s., £14, and £15 10s., according to gauge; while for treble best an additional £2 is quoted upon the respective gauges. Mild steel sheets are £13 for 20 gauge, £14 10s. for 24 gauge, and £16 for 26 gauge; while charcoal sheets are £16 for 20 gauge, £17 10s. for 24 gauge, and £19 for 26 gauge.

The stronger price of black sheets, and a rise in spelter of £1 per ton, which latter means an increase on the cost of the galvanised article of 6s. 6d. per ton, is leading to higher prices being demanded by some of the galvanisers this week. Rumours were upon the market to-day—Thursday—in Birmingham, that circulars had been issued by certainly one leading firm, declaring 10s. per ton. Investigation, however, proved the report to be unfounded. Some other firms, notwithstanding, are trying for more money by 5s. per ton, which would make 24 gauge delivered Liverpool, in bundles, £10 2s. 6d. to £10 5s. Most firms are, however, known to be still willing to accept the old prices, and attempts to secure a rise will meet with some difficulty.

The steel makers continue in receipt of as many orders as they can conveniently execute. This material is fast acquiring additional favour in this district. Prices are still strong at £4 10s. to £4 15s. for Bessemer blooms and billets, and £5 to £5 5s. for tin bars and plating bars, delivered into this district.

Welsh tin-plates are stronger this week by 1s. per box for delivery up here, in consequence of the stoppage of mills through lack of water. Even at the rise makers, consumers here state, do not much care for the business.

Orders for pigs are steadily increasing. Consumers show a desire to speculate before the advent of the quarterly meetings, believing that by so doing they will secure better terms than will then be available. Prices consequently exhibit much firmness, and the advanced quotations of last week are more than maintained. Lincolnshires are 40s. to 41s. delivered at stations in this district; while Derbyshires are quoted 37s., and Northamptons 36s. to 36s. 6d., both at consumers' works. Hot blast all-mine Staffordshire pigs are firm at 50s. to 52s. 6d.; part-mines, 40s.; and common, 28s. 6d. to 30s. First quality hematites are quoted by the Tredegar Company at 54s. 6d. delivered, No. 3 forge at 52s., and No. 4 at 51s. For No. 3 the price of the Barrow Company is about 55s. to 57s. 6d.

The colliery engine tenders in the employ of Lord Dudley have received notice for a reduction of 4d. per day in their wages, which are now 3s. 8d. per day.

Excellent reports continue to reach me of the active demand which is being experienced for railway rolling stock accessories, on account of distant railway companies. One local engineering concern has booked an order for 4000 pairs of wheels and axles for India. The firm has also a lot of other Indian and South American work upon their books. Some other fair inquiries are also on the market for the Indian railways, among them being one for wagon ironwork for the State railways, and steel rails, cast iron sleepers, points, and crossings, and other material for the Indian Midland Railway Company.

The requirements of the Indian telegraph companies in the matter of constructive work are providing a capital thing for this district. There have just been secured by two local firms—Messrs. Bayliss, Jones, and Bayliss, engineers, Wolverhampton, and Messrs. James Russell and Sons, of the Crown Tube Works, Wednesbury—valuable contracts for wrought iron rivetted galvanised telegraph posts. The order placed with one of the firms alone is estimated at 150,000 poles, and it will keep this department of the works fully on for some time to come, and a number of additional hands will have to be engaged. The poles are made in four sections of 8ft. each, and taper upwards from a diameter of about 9in. at the base to about 2½in. at the top, on to which is screwed a small cap. The base of the poles fits into round wrought iron sockets. This is about the third time that similar work has come into this district, and rumour has it that the price of these contracts just secured is about £4 19s. per ton.

Constructive engineers have some better enquiries for bridge-work, in which steel will form a considerable component. The work is mostly for export.

Some of the heavy ironfounders are steadily engaged. All, however, complain of undue competition. Several firms hold some good orders for chilled and other rolls. Pipefounders have some fair work in prospect, there being now upon the market numerous enquiries for pipes and other requirements. Besides iron mains and other castings, the Brixham (Devon) Local Board invite tenders for constructing an iron water-tower. Water pipes are required by the Nottingham Corporation.

Merchant orders in the hardware trades are at date of full average value from the River Plate, Chili, the United States, and Burmah. China also is an improving market for metal, hardware, machinery, and railway material of the cheaper descriptions, and though new Indian orders are momentarily small, there are some important contracts for railway material, waterworks plant, and irrigating machinery under execution for India. The Australian markets are still depressed and unsettled by mercantile failures and other causes, and the indents arriving from New South Wales are mostly for deferred deliveries to secure the advantage of the tariff reduction which comes into operation in October next.

The South Staffordshire and East Worcestershire nailmakers are making a steady move for an advance in wages. The Halesowen jump plate and spike nail makers are organising themselves for this end, and the Birmingham malleable nail makers have unanimously rejected a proposal made to them by the employers.

At a monthly meeting of the South Staffordshire Mines Drainage Commissioners at Wolverhampton on Monday, a rate for the ensuing twelve months was levied, in accordance with the Arbitrators' award, of 3d. upon every ton of fireclay and limestone, and 9d. upon every ton of ironstone, coal, slack, and other minerals not being fireclay raised from the mines in the Tipton district. Mr. E. B. Marten, surface engineer, reported that during the month surface pumping and swag draining had been done at Tipton, and streams to drain swags in Kingswinford and Old Hill had been deepened and repaired.

At a meeting at Wolverhampton, convened by the Amalgamated Society of Railway Servants, Mr. C. E. Stretton, C.E., in the course of an address on "Railways and Railway Work," advocated the universal adoption of the continuous brake and more efficient couplings. The Society had a Bill before Parliament enforcing the adoption of the continuous brake, and he thought that something should be done to compel the railway companies to adopt new forms of couplings. The Society had during the past three years undertaken experiments which showed that there were some couplings perfectly efficient, which would dispense with the necessity of the servants going between the buffers.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Although it can scarcely be said that there is any improvement in the condition of the iron trade of this district, it is certainly no worse, and in some respects is perhaps not quite so bad, as it has been. For pig iron there is rather more inquiry, and prices, though stationary, are showing more firmness at late rates; whilst in finished iron there has been an increased weight of orders going out, which has placed some of the forges in a fair position as regards work on hand, and prices are not being cut down to quite such low figures as they have been of late. Business both in pig and manufactured iron is, however, still only possible at low, unremunerative prices, with no present prospect of any appreciable improvement in this direction.

The Manchester iron market on Tuesday was only moderately attended, and business was again slow, but to some extent a rather better tone seemed to prevail. Pig iron met with some inquiry, which, although it did not result in much actual business, was an indication of more disposition to buy. For Lancashire pig iron makers still quote 38s. 6d. to 39s. 6d., less 2½, for forge and foundry qualities delivered equal to Manchester, and although they are out of the market where they have to compete with district brands, which can be bought delivered equal to Manchester at quite 2s. per ton under the above figures, they are not disposed to meet buyers with concessions of much more than about 6d. per ton, and are content to confine themselves to occasional sales to regular customers, where more favourable rates of delivery place them in a position to obtain their price. In Lincolnshire iron 36s. 6d. to 37s. 6d., less 2½, represent about the average figures for forge and foundry qualities, delivered equal to Manchester, with sellers in some instances at a little under these figures. The fluctuations of warrant quotations at Glasgow and Middlesbrough do not affect makers' prices for Scotch and North of England iron offering here, and these remain firm at late rates, offers at even a trifle under quoted rates being declined.

Makers' quotations for hematites also remain firm at about 53s. to 53s. 6d., less 2½, for good No. 3 foundry qualities delivered into the Manchester district, but there are merchants who would be prepared to sell at 1s. per ton under these figures.

The manufactured iron trade is showing some slight recovery from the extreme depression which has been recently prevailing. Forge proprietors here and there are getting moderately busy, and more firmness is being shown in adhering to current quoted rates; although it can scarcely be said that sellers in all cases are firm at £4 17s. 6d. as the minimum quotation for bars delivered into the Manchester district, there are very few makers who would now come much below this figure, and in some instances they are asking £5 per ton. For hoops, some fair shipping orders have been given out, and prices are more steady at £5 5s. per ton as the quotation for delivery equal to Manchester or Liverpool. In sheets trade is probably more active than in either bars or hoops, but it is only on the very low basis of £6 5s. for local and £6 10s. for good South Staffordshire qualities delivered into the Manchester district.

In the engineering branches of industry, although there is still an absence of any general activity, and the competition for any new work offering continues quite as keen as ever, the tendency of trade would seem to be in the direction of improvement. I hear of more inquiries stirring, and many of the engineering concerns are better off for work than they have been, whilst with regard to employment, the returns issued this month by the Steam Engine Makers' Society show, that apart from the strike at Bolton, and the London district, where trade is reported as very bad, there is a continued steady decrease in the number of members on the books in receipt of out-of-work support.

As I anticipated in my last report, the strike at Bolton has entered upon a more serious phase, and the unfortunate proceedings during the past week have imparted a bitterness to the dispute which can only tend to prolong the struggle. The men have altogether gone beyond the legitimate position taken up in the first place in simply refusing to work on the terms offered by the employers, and not only has gross intimidation been resorted to with the object of preventing the employers obtaining other men willing to work on their terms, but there has been violence and riot, in which the damage done at one of the works—that of Messrs. Dobson and Barlow—has been so serious that it has been necessary to close the works for a week, to effect the necessary repairs, for which, of course, the town will have to pay. The employers are determined not to give way to this species of intimidation, and are more resolved than ever in maintaining the position they have taken up. The men, on the other hand, are equally determined to continne the strike, and they are still receiving substantial support, not only from outside sources, but from their respective trades unions, the Steam Engine Makers' Society having, by an almost unanimous vote, agreed to a special levy to defray the expenses of the strike without touching the general funds. Happily the extra precautions taken by the town's authorities have, during the last few days, prevented any recurrence of the scenes of violence which characterised the close of last week, and which, by rending wider the present breach between the employers and the men, can only tend to injure the industrial interests of the town generally.

The Lancashire and Cheshire district meeting of the Association of Municipal and Sanitary Engineers and Surveyors was held on Saturday at Bolton, when a very full day was spent in visiting the various sanitary works in connection with the above borough. These include the Wellington-yard depôt, where the town refuse is dealt with, the sanitary depôt at School-hill, with disinfecting apparatus, the fever hospital and adjuncts, but the chief place of interest was the new sewage works just completed, for dealing, by the precipitation process, with the sewage not only of the borough, but of the various townships within the Bolton watershed. These works, which have been designed and carried out by Mr. Jonas Proctor, M. Inst. C.E., are divided in two sections. One section is at Burnden, and is practically the utilisation of previously existing works, which have been fitted up with the requisite lime-mixing plant, and are really exclusively employed for the preparation and application of lime or other precipitant to the whole of the sewage which has to be dealt with, and which, having received at this point a mixture of lime and ground ash in the proportion of 8 cwt. of lime and 4 cwt. of ash to every million gallons of sewage, is then passed on through a main sewer one mile in length to the new works at Hacken, where a series of settling tanks have been erected. The sewage, on arriving at the outlet at Hacken, which is the lowest point in the watershed, passes through two penstocks to a catch pit, where gravel and other matter is retained, thence through a screen to a gauge basin, and over the gauge through either of a pair of conduits as desired to a detritus tank, where all solids heavier than flocculent matter are deposited. When this tank is full the sewage, which has left behind the bulk of the suspended matter, flows through a series of outlets into a conduit alongside, having a bell-mouth connection with a system of pipes communicating with settling tanks, each controlled by a valve. These pipes run beneath and through the centre of each tank, and communicate with the surface of the floor by means of three large gratings, up and through which the sewage flows until the tank is full. After a period of rest, the effluent is drawn off from the surface by means of six automatic floats, through another line of iron pipes into the river; or, when it is requisite to clean out the detritus or mud tanks, through a turbine, which actuates a centrifugal pump, by means of which the mud and refuse left in the tanks is pumped on to an adjacent level. The site of the works contains 21¾ acres, and the whole of the walls and floors of the several tanks are made of concrete. The detritus and mud tanks are in duplicate, 96ft. long, 48ft., and 47ft., respectively, wide, 5½ft. deep at the sides, and 8½ft. deep in the centre to the channel line; the settling tanks are three in number, and measure 297ft. long, 96ft. wide, and 6ft. deep. The estimated cost of the works was £34,881, but they have been actually completed for about £4000 under this figure. During the day the members visited the Bolton Town Hall, where they were entertained at luncheon, provided by the Mayor, and in the evening they dined together at the Swan Hotel, Mr. J. Lobley, of Hanley, the president, occupying the chair. In responding to the toast of the Association, Mr. R. Vawser, of Manchester, said, the object they had in view in visiting varicus towns was to acquire information which the members might use for the benefit of the towns and communities they represented, and their visit to Bolton had been a very instructive one, which had been of great interest to every member.

The condition of the coal trade remains unchanged, all descriptions of fuel being in very poor demand, the orders coming to hand being barely sufficient to keep the pits working more than half time, and where more than this is being done stocks are accumulating. Quoted rates are unchanged, but the actual selling prices are very irregular, and are largely determined by the necessities of sellers, who are anxious to clear away stocks. At the pit mouth best coal averages 8s. to 8s. 6d.; seconds, 6s. 6d. to 7s.; common coal, 5s. to 5s. 6d.; burgy, 4s. 3d. to 4s. 9d.; good slack, 3s. 6d. to 3s. 9d.; and common sorts about 3s. per ton.

For shipment there is only an indifferent demand, and very low prices are being taken to secure orders, 6s. 6d. to 7s. per ton being about the average figures for steam coal delivered at the high level, Liverpool, or the Garston Docks.

The South-west Lancashire colliery owners have had another meeting to consider the wages question, but nothing definite has been done.

Barrow.—The steady tone noted last week in the hematite pig iron trade of North Lancashire and Cumberland is maintained, and the demand is well sustained from home, continental, and colonial consumers, but on American account very little is being done. Prices range at 45s. 6d. per ton net f.o.b. for mixed parcels of Bessemer iron, and 44s. 6d. for No. 3 forge and foundry iron. There is a large output, and within the past week two additional furnaces have been put in blast. The steel trade is very busy, and in fact this department of trade is the mainspring of the district because of the great consumption of pig iron and iron ore necessitated to meet the requirements of steelmakers. Rails are still the chief feature of the demand. Makers hold large orders, and they are in receipt of enquiries which show that consumers require very full deliveries in the future. Sales are mostly made for forward delivery, Makers are so well sold forward that they have but little to offer for prompt delivery. The demand for rails is world-wide, and America remains the best customer. Prices for heavy sections are quoted at £4 3s. per ton net f.o.b., the prices quoted last week. Large sales of blooms are offerred and billets and bars are in good request. Shipbuilders have nothing new to report except that Mr. W. John, the general manager of the Barrow Shipbuilding Co., has been successful in securing the prize of 15,000 dols. for the best design for the American Government for war ships. The manager of the Vulcan Steel and Forge Co., Barrow, Mr. R. C. Dickenson, has been appointed, and has commenced his duties, as the manager of the steel works of Messrs. Palmer, Jarrow-on-Tyne. The engineering trade is quiet, except in the marine department, in which some increased activity is noticeable. The iron ore trade is brisk, and sales are noted at 8s. 6d. to 11s. per ton. The coal and coke trades are steady, and shipping is well employed at what are considered easy freights. The Town Hall at Barrow will be opened on the 14th of July by the Marquis of Hartington.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

As I anticipated at the close of the last quarter's trading, Sheffield exports to the United States are again most encouraging for the three months ending June 30th. The total value is £226,049, against £129,443 for the corresponding quarter of last year. This is an increase of £96,606 on the second quarter of 1886, and of £20,262 over the previous quarter, ending March 31st. Steel has been exported to the value of £83,184, against £64,241 for the June quarter of 1886, and £72,897 for the quarter ending March, 1887. Cutlery has been sent to the United States to the value of £46,617, against £45,279 for the corresponding quarter of 1886, and £44,767 for the three months ending 31st March last.

After the fire which occurred at Syracuse—where Messrs. Sanderson Brothers and Co., the well-known steel manufacturers of Sheffield, have their American capital employed—Mr. W. H. Watson, accountant, with Mr. Halcomb, managing director, went out as a deputation to do what was needful in the emergency. They were accompanied by Mr. E. H. Wake, who went for the satisfaction of the chairman—Mr. Bernard Wake—and at his cost. The fire resulted in a loss of nearly £9000, covered by policies, which were adjusted promptly and satisfactorily by the insurance offices. The deputation, whilst at Syracuse, ordered the partial restoration of the works, and subsequently the board at Sheffield directed that they should be entirely re-constructed. The directors report that the American company has got all the requisites for making best cast steel in America, and so has acquired an exceedingly valuable portion. Messrs. Sanderson Brothers and Co., and Messrs. Samuel Newbould and Co., are amalgamated companies, with Mr. Bernard Wake as chairman. During the year, dividends aggregating 5 per cent. have been paid to the shareholders, and an undivided balance of £7761, carried forward. Resolutions have been passed, adopting the report and accounts, and authorising the payment during the current year of dividends at the rate of 5 per cent. per annum.

Mr. J. C. Wragg, senior partner in the firm of John and William Wragg, Johnson-street, Wicker, died on Saturday, at the age of seventy-two. His firm, which was established in the last century, always had a reputation for the production of high-class scissors. Mr. Wragg, was a grand juror at the 1851 Exhibition, and received a gold medal, and autograph from the Prince Consort.

At a time when other towns are suffering so severely from

drought, Sheffield has reason to congratulate itself on the abundant supplies, which forbid all fear of failure for domestic or other purposes. The present consumption is six million gallons per day, and the population is 300,000. The company can give a supply of ten millions a day, which is calculated to be equal to the requirements of a population of half a million inhabitants. Even if the present ample stores at Bradfield and Redmires were to run short, there remains the Dale Dike reservoir, which has an untouched reserve of 486,000,000 gallons. The company—which is about to be purchased by the Corporation, terms having been agreed upon between them—has works authorised sufficient to increase the supply to 15,000,000 gallons per day. The engineer of the Water Company informs me that the average rainfall at Redmires, from 1st January to 30th June, during the fifty-two years, 1836-1887, was 18⅛in., while the fall during the six months of the present year has only been 9¼in. During the period of fifty-two years the lowest recorded registrations were for the corresponding six months of 1844, 11¼in.; 1874, 12in.; 1855, 12⅓in.; 1854, 13in.; 1842, 13$\frac{3}{10}$in.; 1870, 13⅜in.; 1865, 13$\frac{6}{10}$in., all these being years of extreme drought.

The Rotherham Corporation are troubled with their baths, which leak in some mysterious way they have not yet been able to fathom. The committee in charge of the undertaking have decided to call in the services of an expert, and a London engineer is to be asked to solve the secret.

When the great strike of colliers took place in South Yorkshire some years ago a considerable amount of business went to northern coalfields, and never came back. It is now the turn of South Yorkshire. After a contract for the delivery of 64,000 tons of Newcastle coal at Cronstadt, St. Petersburg and Tjora had been signed early in the season, the Russian marine, hearing there was a strike at Newcastle, gave permission for Yorkshire coal to be supplied instead of Newcastle coal. In the meantime Russia is pushing on her preparations to be independent of foreign countries for fuel. Her Black Sea fleet is now largely supplied from the coalfields of the Donetz Valley, for which a port on the Sea of Azoff will shortly be the principal outlet.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

BUT little business has been done in Cleveland pig iron during the last ten days. Prices are, nevertheless, fairly well maintained, and sellers look forward hopefully to the future. The statistical returns for June, showing a decrease in stocks, have just been issued, and they have certainly had a favourable influence on market values. Most buyers expected to see an increase of stocks accompanied by reduced prices. They now seem more inclined to operate, and are quite willing to pay last week's rates. For prompt delivery, No. 3 g.m.b. is offered by merchants at 34s. 6d. per ton, and for August and September delivery at 3d. more. The minimum price at which makers will sell is still 35s., and that figure is said to be readily obtained from foreign customers.

Warrants are now offered at 34s. 6d. per ton, or the same price as makers' iron, but holders are less eager to sell than they were some time since.

The stock of Cleveland iron in Messrs. Connal and Co.'s Middlesbrough stores was increased last week by 2305 tons. The quantity held on the 4th inst. was 336,853 tons, and the increase for the month of June was 6652 tons.

There is nothing new to be said with regard to finished iron. Orders come to hand but slowly, and prices remain unaltered.

The official statistics showing the make and disposal of pig iron for June were issued on the 4th inst. The number of furnaces at work on iron of all kinds was ninety-five, and the total output of Cleveland, hematite, and spiegel, and basic iron was 211,053 tons respectively, a decrease of 7427 tons, as compared with the output durmg May. The total quantity in stock in the whole district was 614,937 tons, being a decrease of 4145 tons for the month.

Pig iron shipments were below the average, the total quantity sent away being 72,155 tons, as against 74,517 tons during May. The coastwise shipments were very good. Scotland took 30,865; Wales, 6685; and Newcastle, 1665 tons. The principal consignments to foreign countries were as follows, viz.:—To Holland, 6593 tons; to Germany, 6553 tons; to Russia, 4290 tons; to the United States, 3600 tons; to Italy, 2310 tons; and to Belgium, 2190 tons. The shipments of manufactured iron and steel amounted to 47,137 tons, or 9895 tons less than during May. Of this quantity India alone took 17,362 tons.

Among the inland cities or towns which have lately become seized with a desire for the advantages possessed by those situated at the seaboard, or on large navigable rivers, is the City of York. As the crow flies, there is an interval of about forty miles between it and the coast. But the river Ouse connects it directly with the sea at Hull, although by a somewhat tortuous course. For many years it has been known that the Ouse was in an unsatisfactory condition, and that nothing was needed beyond the expenditure of a reasonable sum of money to enable sea-going vessels of some hundreds of tons burden to reach the ancient metropolis of Yorkshire. Several eminent engineers have been from time to time consulted, and have made their reports, including Mr. Rhodes, Sir John Coode, Mr. Bartholomew, and Mr. Styan. But no further action has hitherto been taken. There is, in the course of the river, just a single lock, which is situated at Naburn, a small village a few miles below York. This lock was built in 1757, and it will only admit very small vessels. This lock, and the winding character of the river, and its tendency to silt up, are the real impediments to improved navigation.

Lately the whole subject of river improvement has been revived. A sub-committee of the City Council was appointed, and decided to consult Mr. John Fowler, engineer to the Tees Conservancy Commissioners. Mr. Fowler, after a preliminary survey, said that the first thing which ought to be done was to construct a new lock alongside the existing one at Naburn. He advised that it should be 150ft. long by 26ft. wide and 25ft. 3in. in depth, or 3ft. deeper than the present one. Mr. Fowler's scheme also involves the removal of certain buildings, and the construction of a timber breastwork by which a portion of the present river bed will be reclaimed, and a new and straighter channel substituted. He estimates the cost of the proposed alterations at £11,400. As soon as the new lock is made he advises a certain expenditure in dredging, the worst shoals being first removed and the whole river being gradually deepened. He does not see any reason why steamers of 300 tons burden should not ultimately proceed as far as York.

Financially there seems to be every chance that the money spent in these improvements will be redeemed from the tolls taken within a reasonable time, and a surplus of some hundreds a year remain available for other river improvements.

At a meeting of the City Council held some time since the Ouse Navigation Committee were authorised to take all necessary steps for carrying into effect these recommendations, and to raise the money which will be required, on the security of the dues and property of the Navigation Trust. Tenders were subsequently advertised for, and the work entrusted to Messrs. Nelson, of York.

On the 30th of June the ceremony of cutting the first sod of the new lock was performed by the Lord Mayor, Sir Joseph Terry. The subsequent proceedings, although locally interesting, are scarcely likely to be so to ordinary technical readers, except so far as the remarks of Mr. Fowler are concerned. He said that the present lock is the first bar to navigation to vessels ascending the river, and that the new one will be the greatest work which will have to be undertaken. He did not think that there was any use in spending money in dredging or otherwise, unless and until the new lock was made. The river was at the present moment exceedingly low. The Tees was in the same state, indeed lower than he had known it for the last eighteen years. The river Ouse was extremely liable to the deposition of what was called "warp," and it would be necessary to ascertain by exact experiments the rate at which this deposition took place. He was sure that the expenditure of the money in the improvement of the river would affect most beneficially the trade of York and the district.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THE Glasgow pig iron market has been comparatively inactive this week. The continued small shipments have destroyed all faith in the impression which influenced the market during the past few weeks, that we were on the eve of a marked improvement in the demand for pig iron from America. In consequence, the prices of warrants have receded, although the great proportion of the iron in store is held in strong hands. The past week's shipments amounted to 5136 tons, as compared with 6424 in the same week of 1886. There is no change in the amount of the production, and the weekly addition to the stock in Messrs. Connal and Co.'s stores is on the increase, amounting now in the aggregate to 110,000 tons more than at this date last year.

Considering the backward condition of the warrant market, the prices of makers' special brands are well maintained. Free on board at Glasgow, Gartsherrie, No. 1, is quoted at 49s. 6d.; No. 3, 44s. 6d.; Coltness, 54s. 6d. and 45s.; Langloan, 50s. 6d. and 46s.; Summerlee, 52s. 6d. and 43s. 6d.; Calder, 49s. 6d. and 42s. 6d.; Carnbroe, 44s. and 40s. 6d.; Clyde, 46s. 6d. and 41s. 6d.; Monkland, 43s. 6d. and 39s.; Govan at Broomielaw, 43s. 6d. and 39s.; Shotts at Leith, 49s. 6d. and 45s. 6d.; Carron at Grangemouth, 52s. and 44s. 6d.; Glengarnock at Ardrossan, 48s. 6d. and 41s. 6d.; Eglinton, 43s. 3d. and 39s. 3d.; Dalmellington, 44s. and 40s. 6d.

The malleable iron trade is very dull, and there are on all hands complaints of a want of fresh orders.

In the coal trade business has been materially slackening. That is, of course, usual at the present season, but what is occasioning some anxiety is the circumstance that the foreign inquiry is behind that of corresponding times in preceding years. The quantity of coal despatched from Glasgow in the past week was 28,168 tons, Greenock 448, Ayr 7652, Irvine 2268, Troon 3199, Burntisland 10,974, Leith 3049, Grangemouth 10,335, Bo'ness 8180, Granton 2057, and Dundee 1101; total, 77,742 tons, as compared with 98,289 in the same week of 1886, a decrease on the week of 20,547 tons.

The prices of coals have been gradually receding, and this has rendered necessary a reduction in the colliers' wages. At the close of the prolonged strike which took place earlier in the year, negotiations were begun and proceeded a considerable way, for the adoption of a sliding scale to regulate the miners' wages. The scheme was abandoned at the instigation of the miners' agents, but the employers have nevertheless applied the principle of the sliding scale on this occasion to determine the change that should be made in the rate of pay. The reduction of 7½ per cent. is, therefore, the very same as would have been resolved on just now had the sliding scale been adopted.

So far, the colliers have offered no resistance of consequence to the breaking of their pay, but their leaders are again advocating restriction of output as a means of raising prices and wages. The trade holidays, which have now begun in the West of Scotland, will tend to curtail both supply and demand throughout the present month.

The coal trade has slackened in Fifeshire, but the season there has hitherto been a good one, more particularly as the colliers continued at work during the existence of the strike in the west.

The shale miners, who raise the material used by the mineral oil companies, threaten to strike if their wages are reduced. In consequence of the unprofitable nature of the oil trade, and the serious financial crisis with which the companies have been visited, a curtailment of expenditure is inevitable. All the companies are agreed on the subject, and if the miners come out on strike, the dispute is likely to be prolonged until the men are obliged to give away.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

THE character of the coal trade is being watched with the greatest care. Some of the coalowners are still of opinion that the late improvement is only a spurt, but I am glad to find that such an opinion is exceptional, and that several of the leading coalowners are giving practical illustration of this by closing their books decisively against any entries at less than highest quotations for prompt delivery. Bookings forward are generally declined, or looked at with hesitation in the case of best steam coal.

Taking Cardiff coal exports to foreign destinations, I find that in the five months of 1886 ending May the total quantity exported to foreign destinations reached 2,746,443 tons. The total of the five months ending May, 1887, is 3,171,996, a very appreciable increase. There is one feature about the present trade which must be noticed—a thorough understanding amongst coalowners, arrived at by a seemingly intuitive manner, not the result of meetings and union. They feel that the Welsh coal is looking up, that it must be had, and they are resolved that they will not continue to give it away.

Judging from the vessels loading, the export this week will be a very large one.

Swansea showed a great improvement in tonnage last week, sending away 27,000 tons, and so also did Newport. The coasting total of the latter was close upon 23,000 tons.

I note that the list of old coalowners is lessening. Not long ago the death was announced of Glasbrook of Swansea; then of Beddoe, whose grandfather discovered the Mynyddyslwyn seam. This week Rowland Griffiths of Aberfan Merthyr, died; a coalowner himself, but more largely interested in the royalties from other collieries.

The prices now quoted for best steam are from 9s. to 10s., a good deal selling freely at 9s. 6d. Small steam is quoted at 4s. 3d. to 4s. 6d., Rhondda No. 3, 8s. 3d. to 8s. 6d.

As might be expected from the improvement in coal, coke and patent fuel are hardening, and pitwood sells freely at an advance. Present price 15s. 6d. some special selling at 15s. 9d.

There are some minor upsets in the coal district, in addition to the important strike at the Sir George Elliot pit, the property of the Powell Duffryn Company. The men have taken out their tools at this pit. In some of the Plymouth collieries the stokers who wanted higher wages have been paid off, and at others an agitation is being fomented to get a distinct holiday every month. Tredegar and Dowlais are moving in this matter. The objection to such holidays is that it entails heavy loss, a good deal of the pit working, engines, &c., having to be carried on without any return.

The question of the firing clause in the new Mining Regulations still attracts attention, and it is thought the objectionable features will be expunged

Several cases of collier recklessness have come to light again. One was that of two men in Aberdare pit taking off the top of the lamp, and that in a fiery vein where they were working. The circumstances are strangely like those of the Mardy and other explosions, only that in this detection was too prompt to admit of the catastrophe following. As the magistrate remarked, under the new rules these crimes—for they are no other—will be visited with imprisonment.

The general industries of Wales are looking up, though I regret to make an exception, and that in North Wales. There is a serious stoppage at Ruabon Ironworks. I trust that it is only temporary.

Iron manufacture in North Wales, in Flint especially, dates from the Wars of the Roses, and many a good sword used at Bosworth was made there. The South Walian works are the outcome of a commercial and railway age, and, I am pleased to add, are in much better tone than formerly. There is still room for improvement, and steel rails of the best kind at £4 7s. 6d. do not seem to be a paying concern. The chief make, especially at Dowlais and Cyfarthfa, is steel bar, considerable quantities of which are being made. Cyfarthfa is turning out rails for Barry Railway and Docks.

An important cargo of rails from the Welsh works was 1700 tons for San Francisco and another 700 tons for Sweden. Iron ore is coming in a little more freely. Ironmasters are of opinion that a good demand is likely to set in. A good buying colony has just had a heavy vote to enable it to buy rails.

The tin-plate trade continues to present very gratifying features. Such a sweep of stock has taken place that makers are masters of the situation, and command their price. Quantities have been bought for Montreal, New York, France, and Lisbon. Quotations are likely to advance, and buyers, knowing this, are striving to put in orders. One variety of plate—the terne—is causing quite a rush, and the demand appears greater than supply. Bessemer steels are fetching 13s. 9d., coke 13s. 6d., Siemens as much as 14s. 3d. Inferior brands are slightly less in all sorts. Swansea, notwithstanding the drought, is very busy. Imports last week included 1215 tons pig, 160 tons scrap iron, 101 tons steel blooms, 20 tons steel angles.

T. W. Jones, Treherbert, has been elected secretary Sliding Scale Workmen's Society representative. Members elected—W. Abraham, M.P.; P. Jones, Abertillery; W. Walters, New Tredegar; Thomas Griffiths, Blaenavon.

An explosion on board a coal steamer at Cardiff occurred this week. It appears to have been the old tale—naked candle—accumulation of gas from coal in hold. Several men were burnt.

The steamship Iran left Cardiff on Sunday with 6000 tons of cargo and bunkers for Bombay. This may be regarded as a fair week's output from one of the principal collieries. It is fitted, or will be, with a portable electrical apparatus from Saulter and Co. Paris.

The 90,000 colliers who presented a Welsh address to her Majesty full of a general and loyal feeling have been very pleased with the cordial way in which it was accepted. The 90,000 workers are as important an item as any in the industries of England.

NOTES FROM GERMANY.

(From our own Correspondent.)

ALTHOUGH the condition of the Rhenish-Westphalian iron market as a fact has not materially altered within the week, yet it would appear as if the sinking tendency of it had been arrested. To this must also be added the firmer tone which the rolling mill branch has acquired by the Sales Syndicate having now been unanimously and definitively arranged, so that it can come into full force on August 1st next, when presumably the wrought iron branch of the trade will assume a new phase. The tendency in the country is now evidently in the direction of common offices for the selling part of the business for the whole production of a district or combined districts, which obviously leads to the conclusion that the usual conventions do not completely fulfil their purpose which is not to be wondered at. At present there are two sales-bureaux one at Düsseldorf, the other at Kattowitz—Silesia—and Dortmund is spoken of as about to have a third one. The reports from Silesia are still very satisfactory as far as wrought iron is concerned, which is dearer by M. 37.50 p.t. than it was this time last year, and is now M. 127.50 p.t., but for crude iron there is a scarcity of buyers and a restriction of output will be the immediate consequence. Only the better brands command good prices and buyers, but one lot was lately sold at the low figure of M. 22.30 p.t.

In the Rhenish districts iron ores are still for the most part at a discount, but for red steelstone there has been a brisker demand, and several important contracts for it have been closed. The demand for pig iron is weak, though here and there a slightly better call for it has taken place. The prices, such as they are, have been moderately well maintained, but both in Westphalia and in the Siegerland there is much to be desired in the crude iron branch, aggravated to some extent by the high price of coke. There is nothing doing in spiegel, either in or out of the country, except in the sort containing 20 p.c. of Mn., for which some extensive contracts have lately been made. In the month of May 327,282 t. of pig iron were produced, against 282,236 in May last year, and from January 1st till the end of May, 1,527,721 t., against 1,427,572 t. in the same period last year. The demand for rolled iron is satisfactory, and has been so now for some time, and the monthly returns show a diminution of stocks, therefore the late rise from M. 110 to 112 p.t. was perfectly legitimate, but even now it is in no proper proportion to the prices of the raw materials. In plates there is nothing new to report, except that unaltered prices are sustained, neither is there anything to note concerning sheets, except that the mills have sufficient orders to keep them actively employed, and the prices cannot be got to rise beyond M. 127 p.t. The wire-rod branch is no worse than it was, and particularly iron rods have kept their prices tolerably well, but neither buyers or consumers would come forward in face of the sinking prices of pig iron; now perhaps it will be different, as wrought iron has taken a rise, and will probably soon be dearer again, and pig iron is inclined to show more firmness.

The technical papers are amusing their readers with England's jealousy at Japan having lately divided an order between England and Germany, as expressed by some English industrial journal. If true, it is a pity an English journal should show such weakness and furnish a handle to would-be rivals. At Bromberg 7000 tons of rails, and at Berlin 2000 tons, are to be tendered for. Otherwise there is nothing new to relate. There has been of late a slight improvement in the amount of work given out to the machine shops, but the pipe-foundries complain loudly both as to the want of employment and as to prices.

As was anticipated, the export of iron ore from Bilbao last week diminished, and only amounted to 77,616 tons, but this is above the quantity for the same week last June. From January 1st to June 18th, 2,113,369 tons, against 1,575,633 tons last year, have been shipped. The prices have been maintained for Campanil at 7s., and for best red ore 6s. 9d., but a small lot changed hands at 6s. 8d. per ton.

The Belgian market continues firm. The rolling mills which work for export account are exceptionally busy on girders, which are in very great demand, and under this pressure a rise in prices is shortly looked for. Many works cannot accept orders at short dates. One works has just received an order for 2500t. of plates and angle iron for works at the Lisbon Dockyard. The coal trade is satisfactory, the high Maas facilitating the export greatly, and prices are moderately well maintained.

In France only a falling market can be reported. Official quotations are only nominal at 125f. for girders and 135f. for bars, and the official announcement of a lower price is daily awaited.

Inquiries by the "Union of Iron and Steel Masters" concerning the financial results of share companies and the wages question before and after the re-imposition of the duties on iron gave the following results:—Up to the middle of April 233 replies had been sent in from, principally, large ironworks, foundries, and machine shops, amongst which were ninety-four share companies from all parts of the Empire. In January, 1879, these 233 works employed 124,264 workpeople, whose wages amounted monthly to M. 7,681,291, against, in January, 1887, 162,320 workmen and M. 10,740,056 monthly wages—according to which the number of men had increased 38,058, or 30·6 per cent., and the wages M. 3,058,765 per month, or 39·8 per cent. In 1879 each workman, including boys and the lower-paid men, earned an average of M. 61·83 per month, against M. 66·17 in January, 1887. Taking the twelve months of 1886, according to this each workman would have earned more by M. 52·08, which would make for the 233 works—only a portion of which, though the greater one, includes those of the iron industry—an increase of wages equal to the large sum of M. 36,705,180. According to the published balance-sheets of the ninety-four share companies, in 1879—*i.e.*, 1878-79—with a capital of M. 337,689,613, they earned M. 7,261,895, or 2·15 per cent., and last year, 1885-86, with a capital of M. 353,946,684, they earned M. 13,955,569, or 3·94 per cent. an advance of 1·79 per cent.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, June 25th.

ADVICES from the great inland iron centres to-day show that projectors and builders of important works are preparing to place large orders during July for autumn delivery. The condition of the American iron trade can be briefly described as follows:—Production has not been overdone. Stocks of iron and steel are light. Consumption is nearer than was ever before known. Railroad building is being most actively prosecuted. Money is abundant. The railroads show steadily increasing earnings, and hence heavy requirements are being placed. The car builders and locomotive makers have long contracts in hand. Material of all kinds and fuel are steady. Foundry irons are delivered at 19 dols. to 21 dols.; English Bessemer, 20 dols.; spiegel, 20 per cent., 27 dols.; slabs and billets, 28 dols. to 30 dols.; merchant bars, 2c.; nails, 2·00 dols. to 2·20 dols.; plate iron, 2¼c. per lb.; angles, 2¼, and beams and channels, 3¼; steel rails, 39 dols. for winter and 40 dols. for summer delivery. Pittsburgh mills are all on double turn. The puddlers want a 10 per cent. advance. This, if given, will affect the entire region west of the Allegheny Mountains.

Large ore developments are being made in several States. Valuable bodies of ore are being discovered in new localities. The latest "strike" is in Llano, county Texas, where also coal is found in large quantities.

The development of the coal and iron and manufacturing interests of Northern Alabama is extraordinary. Three blast furnaces have just been projected, and two rolling mills. This prosperity is due in large part to the great activity in railroad construction in the Southern States. The progress of railroad construction for the first half of the year has been slow, but makers are now taxing the capacity of railroad companies to forward rails. Ten thousand Italians have been set to track-laying within a month. Labour of all kinds is in demand, and high rates of wages prevail in all industries.

NEW COMPANIES.

THE following companies have just been registered:—

Automatic Novelties Company, Limited.

This company proposes to acquire British, Colonial, American, or other patents in connection with an appliance for supplying perfume, goods, liquids, or information by means of a coin or equivalent placed therein. It was registered on the 29th ult., with a capital of £25,000, in £1 shares. The subscribers are:—

	Shares.
A. O. Chudleigh, Richmond-gardens, Upton, printer	1
J. Grunell, 53, Tillotson-road, Lower Edmonton, secretary to a company	1
S. H. Blumfield, 39, Sussex-road, Holloway	1
H. Field, 34, Mansfield-street, Kensington, stationer	1
H. de Stedingk, 23, Sinclair-gardens, Kensington	1
T. F. Ross, 75, Middleton-road, Dalston, commercial traveller	1
J. R. Smith, 17, Lowfield-road, West Hampstead, glass manufacturer	1

The number of directors is not to be less than two, nor more than five; the subscribers are to appoint the first; qualification, 500 shares; remuneration, £50 per annum each, and a further sum equal to one-twelfth of the surplus net profits after payment of 12½ per cent. on the paid-up capital.

Elieson Electric Company, Limited.

This company was registered on the 24th ult., with a capital of £600,000, in £5 shares, to take over the assets and liabilities of the Electric Locomotive and Power Company, Limited, and to carry on business as electrical and mechanical engineers in all branches. The subscribers are:—

	Shares.
*The Earl of Galloway, 17, Upper Grosvenor-street	1
*T. Wickham, Leytonstone	1
*W. H. Prothcroe, 67 and 68, Cheapside, auctioneer	1
*C. P. Elieson, Leytonstone, electrician	1
*H. E. Lester, Leytonstone, shipbuilder	1
*J. J. Griffiths, 283, Kingsland-road, merchant	1
R. Vincent, 20, Budge-row	1

The number of directors is not to be less than three, nor more than twelve; the first are the subscribers denoted by an asterisk; qualification, £2000 in shares or stock; remuneration, £2000 per annum.

Emu Bay and Mount Bischoff Railway Company, Limited.

On the 29th ult. this company was registered, with a capital of £60,000, in £5 shares, to acquire from the Van Diemen's Land Company the existing railway from Emu Bay to Waratah, Mount Bischoff, Tasmania, with the buildings, rolling stock, and equipment thereof. The subscribers are:—

	Shares.
C. G. Hale, 26, Austinfriars, stockbroker	20
J. H. Hutchinson, 15, Angel-court, stockbroker	20
W. Brookes, 31, Finsbury-circus, secretary to a company	1
T. J. Reeves, 16, Essex-villas, Kensington, merchant	20
F. C. D. Huggard, 26, Austinfriars, stockbroker	1
C. H. Hale, Sevenoaks, Kent	1
E. Latham, 16, Mildmay Park, clerk	1

The number of directors is not to be less than three, nor more than five; the subscribers are to appoint the first and act *ad interim*; qualification, £100 in shares or stock; remuneration, £500 per annum.

H. C. Bull and Co., Limited.

This company was registered on the 23rd ult., with a capital of £1,000,000, in £10 shares, to manufacture and deal in sulphate of ammonia and its bye-products, and also in aluminium and metal alloyed therewith, and magnesium and other metals; and to acquire letters patent for an "Improved process for the manufacture of sulphate of ammonia," an "Improved electric metallurgical process and apparatus therefor," an "Improved dynamo," an "Improved electric storage battery," an "Improved motor," and an improved system for the treatment of sewage and town refuse. The subscribers are:—

	Shares.
*Sydney Bush Cripps, 14, Graham-street, City-road, marble merchant	1
P. N. Cobbett, Mortlake, Surrey	1
*F. W. Potter, 17, Queen Victoria-street, E.C.	1
*T. S. Lindsay, 31, Poultry, chartered accountant	1
B. F. Weeks, 33, St. Oswald's-road, N.W., merchant	1
J. Anderson, 31, Poultry, chartered accountant	1
A. P. Meikle, The Avenue, Gipsy-hill, accountant	1

The number of directors is not to be less than three, nor more than seven; qualification, 50 shares; the first are Messrs. S. Bush Cripps, F. S. Lindsay, and F. W. Potter; remuneration, £1000 per annum, with travelling and personal expenses, and 5 per cent. on the amount of any dividend exceeding 10 per cent. per annum. Power is taken to set aside a portion of the capital, which will be vested in the directors, and be designated "Treasury Stock," which shall be entitled to participate in profits and dividends in the same manner as other portions of the capital, with power to apply the dividends to the purchase of the shares of the company by tender. The Treasury Stock will be opened by the appropriation of £200,000 of capital, and the amount may be increased by purchases or decreased by sales of the shares of the company at the will of the directors. Mr. Thos. Stevens Lindsay is appointed managing director.

Patent (Lock) Stopper Company, Limited.

This company was registered on the 23rd ult., with a capital of £60,000, in £1 shares, to take over the business of the Duplex Lever Capsule Company, Limited. 16,000 of the shares are 10 per cent. preference shares, and the remaining 44,000 will be issued as ordinary shares, credited with 15s. as paid upon each. The subscribers are:—

	Shares.
Lieutenant-Colonel V. H. Labrow, 101, Leadenhall-street	1
A. Stein, 17, Great Winchester-street, writer to the signet	1
A. Kerly, 14, Great Winchester-street, solicitor	1
H. C. Murchison, 8, Austinfriars, secretary to a company	1
H. Collins, 4, Parolles-road, Highgate, clerk	1
C. M. Pound, 158, Mercer's-road, N., clerk	1
A. G. Thiselton, 20, Queen's-terrace, Peckham, clerk	1

The number of directors is not to be less than two, nor more than four; the first are Edward Amphlett, of 2, Queen's-gate-terrace, S.W., and C. F. Evans, 26, Birchin-lane; remuneration, £50 per annum each, and in any year in which 15 per cent. dividend is paid a further sum equal to 2½ per cent. of the profits arising from articles manufactured and sold by the company.

Patent Motive Power Company, Limited.

This company was registered on the 25th ult., with a capital of £30,000, in £1 shares, to acquire and work the letters patent of Mr. Francis Windham, No. 3697, dated 16th March, 1886. The subscribers are:—

	Shares.
R. J. Richardson, Anfield, Lancashire, physician	1
E. Pendlebury, 20, North John-street, Liverpool, engineer	1
A. Francis, C.E., 20, North John-street, Liverpool	1
K. Stewart, 12, Church-street, Liverpool, merchant	1
J. St. Aubyn, 6, Sturgeon-road, Walworth, accountant	1
J. Macnab, 10, Bayley-street, Bedford-square, engineer	1
W. B. Caulfield, 73, Ferndale-road, Clapham	1

The number of directors is not to be less than three, nor more than seven; the subscribers are to appoint the first and act *ad interim;* qualification for subsequent directors, 250 shares. The company in general meeting will determine remuneration.

Poole Steam Towing and Fishing Company, Limited.

This company proposes to acquire the steamship Pendragon, and to carry on at Poole the business of a towing and fishing company. It was registered on the 24th ult., with a capital of £5000, in £5 shares. The subscribers are:—

	Shares.
*J. Perston, jun., Poole, timber salesman	60
*H. Burden, jun., Poole, shipping agent	60
*H. Burden, sen., Poole, merchant	60
J. Perston, Poole, spinster	4
H. J. Seymour, Bournemouth, clerk	1
*W. A. Stone, Parkstone, shipowner	6
A. G. Burden, Poole, clerk	4

The first directors are the subscribers denoted by an asterisk, and Mr. J. A. Stevenson, of Leith.

PROPOSED CANAL AT BARCELONA.—Attention has lately been given at Barcelona to a project for a canal which would supply the domestic, industrial, and agricultural requirements of certain districts in the vicinity of that city. It is stated by the *Revista Tecnologico-Industrial* that from 3000 to 5000 acres of land can be irrigated by this canal. As there is a variation of level amounting to about 400ft., there would be a certain number of sluices, the force thus available being estimated at 4800-horse power, one-third of which would be utilised in the distribution of water through pipes. The water would be obtained from the Llobregat; the needful precautions being taken to prevent the navigation of that river from being affected. The canal is intended to begin at San Vicente de Castellet, the main channel having a length of 33 miles, with right and left branches respectively 6¼ and 3¼ miles in length. The estimated cost is about £1,116,000. It is proposed to sell for £20 privileges of receiving in perpetuity a cubic metre of water daily—35·34 cubic feet—with an extra yearly payment of 9s. 7d. for administrative charges, &c. It is remarked that the execution of the work should be such as to preclude the repetition of the inundations which took place at Lorca, and the filtration recorded in connection with the Urgel Canal.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

28th June, 1887.

9127. CURTAIN RINGS, J. W. Leslie, London.
9128. GOVERNORS, G. E Dow, London.
9129. METAL FOUNDING, H. Tabor, London.
9130. WASHING MACHINE, H. C. Glinsmann, London.
9131. CARTRIDGES, J. T. Williamson, London.
9132. GLOBE-HOLDER, H. Harper, Birmingham.
9133. LOOMS, G. Hodgson and W. Tetley, Halifax.
9134. BOILERS, A. Bland and S. Brearley, Halifax.
9135. ROLLING RODS, J. F. Haskins.—(*C. D. Haskins, United States.*)
9136. SNARL PREVENTER, W. Taylor, Oldham.
9137. WASHING BOTTLES, C. B. Inman, Hunslet.
9138. PIPES, A. F. Morrison and G. Ingram, Manchester.
9139. LOOMS, S. Hartley, Yorkshire.
9140. PLANING, S. S. Hazeland, Cornwall.
9141. CARTRIDGE, W. Hill, Staffordshire.
9142. PROPULSION, W. Wright, Newcastle-upon-Tyne.
9143. RACK PULLEY, P. Kingwill, Torquay.
9144. BICYCLE, E. Lambert, London.
9145. SPECIFIC for COLDS, T. Hill, London.
9146. CLUTCH, M. Walton-Brown, Newcastle-on-Tyne.
9147. TRAINING PLANTS, C. P. Day, Bedford.
9148. FLUES, J. H. Cormack, Glasgow.
9149. HORSE-SHOE, D. MacWhinnie, London.
9150. RATTLE, R. E. Eades, London.
9151. STOP for WATCHES, J. Robinson, London.
9152. BUTTONS, W. Fraser, London.
9153. CORD RACK, W. Fraser, London.
9154. BOXES, H. Taylor, London.
9155. CHECKING FARES, A. J. Aspinall, Liverpool.
9156. STUD, W. P. Greaves, Birmingham.
9157. BOX, A. Dickinson, Birmingham.
9158. UMBRELLA, H. Dann, London.
9159. PHOTOGRAPHS, J. Bartos and H. Kühn, London.
9160. REFRACTORY MATERIAL, J. Ashworth, London.
9161. EXCAVATING, H. Carter, Ottawa.
9162. CARTRIDGES, E. O. Eaton.—(*J. Lancaster, United States.*)
9163. TOY, E. O. Eaton, London.
9164. HOLDING CLOTHES, E. O. Eaton.—(*J. Lancaster, United States.*)
9165. BLINDS, M. Smout, London.
9166. ELECTRICAL CONDUCTORS, W. M. Riddell, London.
9167. PRINTING MACHINES, J. C. Mewburn.—(*J. Derriey, France.*)
9168. TRIMMING APPARATUS, G. and J. H. Taylor, London.
9169. MINERS' SAFETY LAMPS, &c., E. Patterson, London.
9170. HARMONIUMS, J. Robinson, Swansea.
9171. PROPELLERS for SHIPS, F. H. Snyder, London.
9172. MACHINES for MAKING METALLIC ROOFING, L. L. Sagendorff, London.
9173. GRINDING MACHINES, J. Whittingham, London.
9174. MANUFACTURE of MINING IMPLEMENTS, G. H. Jones, London.
9175. CIGARETTES, G. H. Jones, London.
9176. CIGARETTE TIPS, G. H. Jones, London.
9177. TYPE-WRITERS, H. H. Lake.—(*A. G. Donnelly, United States.*)
9178. SIGNATURES, H. H. Lake.—(*F. D. Taylor and J. A. White, United States.*)
9179. LOOMS, &c., H. H. Lake.—(*J. Widmer, United States.*)
9180. KNITTED FABRICS, T. H. Carroll, London.
9181. RENOVATION of STEEL PENS, L. M. H. M. Dahms, London.
9182. TOOLS for DRILLING, H. H. Lake.—(*J. W. Heyer, United States.*)
9183. DRESSING POLLARD, &c., E. Kreiss, London.
9184. COLOURED DESIGNS upon PLATES, &c., E. D. J. Neupert, London.
9185. FACILITATING the TAKING of MONEY, F. H. Snyder, London.
9186. TILLING LAND, A. England, London.
9187. SEWING MACHINE, A. Reichert and G. S. Yuigling, London.
9188. SULPHURIC ANHYDRIDE, E. Hänisch and M. Schröder, London.
9189. WOOD-PLANING, &c., MACHINE, T. R. Shillito.—(*W. Fischer, Germany.*)
9190. COMBINED CARRIAGE AXLE ARM and WHEEL HUB, E. T. Phipson and G. Birchley, London.
9191. TYPE-PRINTING TELEGRAPHS, G. A. Scott, London.
9192. WEARING APPAREL, E. Tomlinson, London.
9193. INSTRUMENTS to ASSIST HEARING, W. H. Mason.—(*L. P. Townley and W. J. Washburn, United States.*)
9194. AZOIC COLOURING MATTERS, J. Imray.—(*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier, Z. Roussin, and D. A. Rosenstiehl, France.*)
9195. COLOURED GLASS-WARE, M. R. von Spaun, London.
9196. CHANGING ELECTRIC CURRENTS, A. J. Boult.—(*S. Doubrava, Austria.*)
9197. CANNON, A. J. Boult.—(*E. J. Blood, United States.*)
9198. PNEUMATIC GUNS, N. W. Pratt, London.
9199. COOLING or HEATING LIQUIDS, &c., A. J. Boult.—(*J. Fischer, Austria.*)
9200. IRON or STEEL, A. G. Greenway, Liverpool.
9201. REFRIGERATORS, T. M. Stephenson, Liverpool.
9202. EYE-GLASSES, W. P. Thompson.—(*C. W. Taylor, United States.*)
9203. PIPE-CUTTERS, W. P. Thompson.—(*C. A. Barnes and D. Mathews, United States.*)
9204. FAUCETS, J. Howes, Liverpool.
9205. PACKING GRANULAR SUBSTANCES in CASKS, R. H. Davies, Liverpool.
9206. ROTARY FILTERING APPARATUS, J. Howes, Liverpool.
9207. CANDLESTICKS, G. Mang, Liverpool.
9208. CLEANING INTESTINES, H. H. Lake.—(*S. Oppenheimer, United States.*)
9209. EXPLOSIVES, L. G. Heusschen, London.
9210. ELECTRO-MAGNETIC TELEPHONES, H. Collet, London.
9211. COLOURING and DRYING PAPER, R. Crompton, London.
9212. PAPER FASTENERS, H. J. Haddan.—(*G. Gros and Messrs. P. O'Kelly et Cie., France.*)
9213. EXPANDING WHEELS, W. G. Scott, London.
9214. SELF-LUBRICATING VEHICLE AXLES, E. Firth, London.
9215. TRANSFUSION of BLOOD, R. Haddan.—(*E. E. Allen, United States.*)
9216. DRIVING GEAR, T. R. Marriott and F. Cooper, London.

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9217. GUN CARRIAGES, R. C. Christie, M. Gledhill, and H. H. S. Carington.—(*J. B. G. A. Canet, France.*)
9218. STOPPING POWER LOOMS, J. and E. Horrocks, Bradford.
9219. PRESERVING ALE in BARRELS, A. G. Greenaway, Liverpool.
9220. ADJUSTABLE STAND for GLASSES, J. A. Richards, Birmingham.
9221. TANDEM or FOUR-IN-HAND HARNESS, J. C. Shaw, Dublin.
9222. COLLAR and SHIRT STUDS, W. H. Sheldon, Birmingham.
9223. IMPROVEMENTS in BOBBINS, &c., J. H. Wilson, Manchester.
9224. TAPE FASTENER, I. Jackson, Glossop.
9225. ADMINISTERING MEDICINES, E. A. B. Beaumont, Brighton.
9226. CARTRIDGES for ORDNANCE, A. C. Koerner, Paris
9227. BI-CARBONATE of SODA, C. Wigg, Liverpool.
9228. COUPLING RAILWAY WAGONS, J. McNiven, Newcastle-on-Tyne.
9229. SADDLE HARROWS, J. Forster, Brampton.
9230. GRATING, &c., NUTMEGS, &c., E. J. Adams, Sheffield.
9231. CONVERTER, J. Toussaint, Hollywood, near Birmingham.
9232. CIRCULAR KNITTING MACHINES, A. Chapman London.
9233. PENCIL HOLDERS, O. Bussler, Berlin.
9234. FRAMES for FAC-SIMILE or TRANSFER PRINTING A. C. Thompson, Glasgow.
9235. MINERS' SAFETY LAMPS, J. Treherne, Llanelly.
9236. EQUILIBRIUM SLIDE VALVE, J. Griffiths and J. M. Anthony, London.
9237. CURE of SEA SICKNESS, W. H. Wheeler and W. A. Ingram, Norbiton.
9238. HUBS of WHEELS, S. Gould, London.
9239. BRACKET for SUPPORTING STOVE-GRATE ORNAMENTS, &c., F. Cooper, London.
9240. STOPPERING BOTTLES, JARS, &c., T. Singleton, London.
9241. SHIPS' DAVITS, T. Knudson, Bristol.
9242. SIGNALLING APPARATUS, J. C. Dobbie, Glasgow.
9243. TRAMWAY RAILS, &c., J. Rothery and J. Warburton, Conisburgh, near Rotherham.
9244. FENDER and FIRE-GUARD COMBINED, H. J. Cook, Crabb's Cross, near Redditch.
9245. FLUSHING APPARATUS, H. Dodd, Liverpool.
9246. VENTILATION, W. P. Thompson.—(*E. H. Oehlmann, Berlin.*)
9247. PRESERVING FISH, J. F. V. Steenberg, London.
9248. WHEELS for BICYCLES, &c., C. Inwood, Gravesend.
9249. PRODUCING RELIEF BLOCKS for PRINTING, W. P. Simmons, London.
9250. AMALGAMATING APPARATUS, A. M. Clark.—(*T. D. Williams, South African Republic.*)
9251. RUBBER-TIRED TENSION WHEELS, A. Burdess, London.
9252. RING-SPINNING MACHINES, T. Rivett, Manchester.
9253. A PUZZLE, J. H. Herbert and L. D. Reading, London.
9254. VELOCIPEDES, J. Asbury, London.
9255. ATTACHING METAL HANDLES to GLASS and other ARTICLES, P. M. Beck, London.
9256. REGULATING the SPEED of DYNAMOS, J. L. Yuly and H. W. Andrews, London.
9257. AZOIC COLOURING MATTERS, J. Imray.—(*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier, Z. Roussin, and D. A. Rosenstiehl, France.*)
9258. VENTILATING HATS, M. Postlethwaite, London.
9259. FIRE-ESCAPE, C. MacMahon, London.
9260. PROTECTIVE CUSHION for the HOOFS of HORSES, W. L. Wise.—(*C. Volant, France.*)
9261. DISENGAGING SHIPS' BOATS, C. A. Petterson, London.
9262. FRICTION COUPLINGS, J. Gawron, London.
9263. FACILITATING ARITHMETICAL CALCULATIONS, H. H. Lake.—(*R. Miller, Germany.*)
9264. CHRONOSCOPES, J. G. Lorrain, London.
9265. CAR BRAKES, A. H. Marden, London.
9266. ENAMELLING FABRICS, G. R. McDonald and P. F. Bennett, London.
9267. COUPLING WAGONS, E. J. Hill, London.
9268. PRODUCTION of ARTIFICIAL COLD, F. A. Smith, London.

30th June, 1887.

9269. HORTICULTURAL BUILDINGS, J. Pratt, Sydenham.
9270. RETTING, &c., RHEA, &c., H. M. Girdwood, Manchester.
9271. REGULATING the SPEED of STEAM ENGINES, J. Harrison, Manchester.
9272. STEERING JOINTS for VELOCIPEDES, T. A. Aston, Birmingham.
9273. AUTOMATIC SILK REELING MACHINES, E. W. Serrell, jun., Paris.
9274. REELING SILK from the COCOON, E. W. Serrell, jun., Paris.
9275. SWIFT for SILK or COTTON WINDING, C. and J. Higginbotham, Macclesfield.
9276. INJECTORS, J. Fletcher, Ashton-under-Lyne.
9277. SPRING HINGES, J. Wilson, Liverpool.
9278. RACKS used in ENDLESS OPERATING CORDS of WINDOW-BLINDS, J. B. Moorhouse and A. M. Midgley, Keighley.
9279. PICKING MOTION for actuating the PICKER in LOOMS for WEAVING, J. and E. Horrocks, Bradford.
9280. BOTTLING LIQUORS, G. S. Spencer, Derby.
9281. RAISING or LOWERING GAS and other LIGHTS, T. W. Helliwell, Halifax.
9282. VELOCIPEDES driven by a CHAIN or BAND, M. Woodhead and P. Angois, Nottingham.
9283. RING FRAME BOBBINS, J. Coward, Manchester.
9284. TRANSVERSE SLEEPERS, &c., J. W. H. James, Liverpool.
9285. NUTS for SCREW BOLTS, J. W. H. James, Liverpool.
9286. SEGMENTAL METALLIC CORE BAR, A. and R. Crighton, Handsworth.
9287. COMBINATION LAMP and BLOW PIPE, H. Bush, Yorkshire.
9288. CANDLES, H. Dalgety, London.
9289. DRAWING LIQUOR from BOTTLES, W. J. Payne, London.
9290. PENCIL-HOLDERS with EXPELLING MECHANISM, O. Bussler, Berlin.
9291. BRIGHT PRINTING GOLD, M. F. L. Ehrlich and C. T. Storck, Berlin.
9292. DECORATIONS on CHINA, M. F. L. Ehrlich, Berlin.
9293. TOBOGGANING, F. Howcroft, London.
9294. GLAZING PAPER, G. Kirkman, London.
9295. REIN HOLDERS, W. C. Roberts, London.
9296. KNOT, A. J. Allan, Glasgow.
9297. GARDEN RAKES, F. Parkes, Birmingham.
9298. BRACKETS for ROLLER ENDS, C. Showell, Birmingham.
9299. COLOURING MATTER, G. Tall and W. P. Thompson, Liverpool.
9300. FASTENINGS for SCARVES, W. Bilsborrow, Liverpool.
9301. SUPPORTING SHADES over CANDLES, J. F. Marchant and J. S. Browne, London.
9302. EXPANDING MANDRELS and TAPS, J. Whiteley, London.
9303. MULES or TWINERS, J. Haughton, London.
9304. PHOTOGRAPHIC SHUTTER, W. E. Kerslake, Liverpool.
9305. AUTOMATIC ADVERTISING, T. Atkins, Wimbledon.
9306. CONNECTING the ENDS of DRIVING BELTS, T. Brown, London.
9307. STOPPING TRAM-CARS, W. H. Steil, London.
9308. BED MILLSTONES, J. T. Stapelton, London.
9309. LOWERING COFFINS into GRAVES, D. North, London.
9310. TRIMMING BURNER WICKS, A. Meyer, London.
9311. SMOKE and SPARK CONDUCTORS, J. Howe, London.
9312. ADVERTISING, G. F. Redfern.—(*S. Bing, Bavaria.*)
9313. ALLOYS of ALUMINIUM, A. Mann, London.
9314. GAS STOVES, J. E. Potain, London.
9315. AZOIC COLOURING MATTERS, J. Imray.—(*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier, and D. A. Rosenstiehl, France.*)
9316. STEEL, R. A. Hadfield, London.
9317. SKATES, O. Eckenstein and V. I. Feeny, London.
9318. LIFTS, H. H. Lake.—(*M. Rossbach, Germany.*)
9319. TREATING TEA LEAF, W. H. Gilruth, London.
9320. LADIES' KNITTED VESTS and JERSEYS, G. Sowter, London.
9321. ELONGATED PROJECTILES, J. J. C. Smith, London
9322. CASTING METALS, J. J. C. Smith, London.
9323. LATHE ATTACHMENT, G. Banks, B. R. Banks, and A. J. Gale, London.
9324. DISINFECTING APPARATUS, E. Edwards.—(*N. Goblet, France.*)
9325. LAMP CHIMNEY WATER HEATER, E. P. Blackmur, London.

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9326. COMBINATION MACHINE, W. S. Oliver, London.

9327. NEW GAME of CHANCE, W. S. Oliver, London.
9328. INTERMITTENT VALVE ACTION for WATER-CLOSETS, &c., S. S. Bromhead.—(*Y. Beylier, France.*)
9329. DIVIDING COTTON and other FIBROUS MATERIALS, J. E. Renshaw and J. Schofield, Rochdale.
9330. WIRE ROPES, L. Hill, Stockton-on-Tees.
9331. MINERS' SAFETY LAMPS, J. J. Hardy, Stockton-on-Tees.
9332. LAMP, &c., F. R. Baker, Birmingham.
9333. LETTING-OFF MOTION of POWER LOOMS, W. Pennington, Blackburn.
9334. SECURING INDIA-RUBBER TIRES to the RIM of BICYCLE and other WHEELS, M. Stubley, Halifax.
9335. PIERCING the ENDS of WOVEN BELTING, &c., H. B. Barlow, Manchester.
9336. AUTOMATICALLY CLOSING VALVES, R. Brough, Sunderland.
9337. KEY RING, F. Larkins, Bradford.
9338. VAN BOXES or PACKING CASES, D. Rylands, Barnsley.
9339. COMPOUNDS for INSULATING TELEGRAPHIC WIRES, SUBMARINE or LAND, A. Wilkinson, London.
9340. DUPLEX-EDGED BANDS, &c., I. and I. Brough, Nicholson, and Co., Leek.
9341. CHANGING BOXES and DARK SLIDES for PHOTOGRAPHIC PURPOSES, A. Pumphrey, Birmingham.
9342. TABLES and SEATS for GARDEN USE, A. Paget, Radmoor.
9343. TURNING LATHES, J. Barrow, Glasgow.
9344. LATHES for TURNING SHAFTS, J. Barrow, Glasgow.
9345. GRINDING MILLS, F. Beall, London.
9346. PENCIL SHARPENERS, &c., F. D. Butler, London.
9347. LENS, J. Walsh, London.
9348. HYDRAULIC MOTIVE-POWER ENGINE, R. Roberts and J. Jardine, London.
9349. LOCK-NUTS and BOLTS, G. H. Aylett, London.
9350. POLISHING YARN, E. Casper.—(*J. Papleux, France.*)
9351. HYDROSTATIC WEIGHING MACHINES and DYNAMOMETERS, H. Duckham, London.
9352. CRICKET BATS, A. Shaw and A. Shrewsbury, London.
9353. COMPOUNDS for TANNING, W. P. Thompson.—(*J. P. N. Bidron, France.*)
9354. AUTOMATIC WORKING of RAILWAY SIGNALS, F. E. G. de Laguerenne, Liverpool.
9355. VELOCIPEDES, P. S. S. Nicklin, London.
9356. MECHANISM for VELOCIPEDES, &c., F. I. Nibbs, London.
9357. INCREASING the SECURITY of BILLS of EXCHANGE, A. Goldstein, London.
9358. ORNAMENTING in COLOURS MATS, &c., W. J. Sly, London.
9359. STRAPS or REINS used in CONTROLLING HORSES, W. Kennedy, London.
9360. AUTOMATICALLY COUPLING RAILWAY VEHICLES, L. B. Bertram, London.
9361. PRODUCING DEFINED PATTERNS in CELLULOID, T. M. Denne, London.
9362. ILLUSTRATING the MOTIONS of the EARTH, &c., P. Lagrange, London.
9363. WINE from BARLEY, &c., G. E. Jacquemin, London.
9364. WORKING HIDES, SKINS, &c., G. Baruelle fils, London.
9365. BLAST FURNACES for SMELTING ORES, C. E. Miles, London.
9366. IRON JOIST TRIMMER, &c., W. Hooker, Croydon.
9367. STOP-COCKS, A. C. Gibault, London.
9368. CORSETS, F. Reast, London.
9369. DOORS of CARRIAGES, E. de Pass.—(*J. Escuyer, France.*)
9370. MINERAL SPIRIT LAMPS, W. H. Beck.—(*O. Proust, France.*)
9371. HOISTING MACHINES, H. McLaughlin and J. B. Maling, London.
9372. EXTRACTOR MECHANISM, H. W. Holland and J. Robertson, London.
9373. LAYING GUNS, R. C. Christie, M. Gledhill, and H. H. S. Carington.—(*J. B. G. A. Canet, France.*)
9374. COLLAR STUDS, SOLITAIRES, &c., O. Rafflenbeul, London.
9375. FACILITATING the LOADING of GUNS, R. C. Christie, M. Gledhill, and H. H. S. Carington.—(*J. B. G. A. Canet, France.*)
9376. SOAP, J. Harris, London.
9377. TRANSMITTING SUBMARINE SIGNALS, F. H. Boyer, London.
9378. GRAIN CRADLE, P. B. Nalley and M. R. Reames, London.
9379. APPARATUS for STRETCHING TROUSERS, W. Buck, London.
9380. SAFETY APPARATUS, E. T. Cleathero and J. F. Stewart, London.
9381. AZOIC COLOURING MATTERS, J. Imray.—(*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier and D. A. Rosenstiehl, France.*)

2nd July, 1887.

9382. HINGED STOPPER for JARS, &c., G. F. Henshall, London.
9383. PICKERS, E. Barraclough, Rochdale.
9384. VENTILATORS, J. Miller, Liverpool.
9385. DIFFERENTIAL GEARING, J. Dugdale and J. F. Davies, Manchester.
9386. EYES of NEEDLES, L. C. Haines and J. Morgan, Redditch.
9387. PROJECTILES, C. A. Burghardt and W. J. Twining, Manchester.
9388. SPINDLE MOUNTINGS, J. Morris, Manchester.
9389. ALUMINIUM, C. A. Burghardt and W. J. Twining, Manchester.
9390. SWINGING BRACKET for TUMBLERS, J. G. Wilson, London.
9391. PREVENTING the CHOKING of PIPES, C. S. Ellery and J. Chaffin, London.
9392. GAS MOTOR PUMPS, J. P. Lea, Luton.
9393. REGISTERING GAMES, J. G. Dodds, Newcastle-on-Tyne.
9394. PISTON SPRINGS, G. Robson, Sunderland.
9395. CUTTING PILED FABRICS, G. Roger, Manchester.
9396. DETECTING the USE of PIECES of LEAD, &c., instead of COIN in AUTOMATIC SUPPLY MACHINES, W. E. Richardson, Sheffield.
9397. ROLLER MILLS, R. Burns, Rugeley.
9398. FIRE-GRATES, J. Jobson, London.
9399. EJECTING SPENT CARTRIDGE CASES, J. Dickson, Glasgow.
9400. BUTTON, G. and M. J. Stowe, Great Grimsby.
9401. RENDERING CONCEALED OBJECTS VISIBLE, G. C. Bingham.—(*C. H. Bingham, Holland.*)
9402. WASHING, DRAINING, &c., RACK, W. Tylar, Birmingham.
9403. TREATMENT of ACID RESIDUUMS, C. Rave, Liverpool.
9404. CAROTTING SKINS, M. J. A. Dargelos, Liverpool.
9405. INNER ADJOINING SELVEDGES, J. Haydock and R. Hindle, London.
9406. COLLAPSIBLE CIGAR, &c., CASE, G. E. Johnstone, London.
9407. BRACES, E. Tomlinson, London.
9408. MECHANICAL TOY, E. O. Eaton.—(*J. Lancaster, United States.*)
9409. TYPE WRITERS, E. O. Eaton.—(*J. Lancaster, United States.*)
9410. HOT AIR FURNACES, J. A. Newton.—(*R. A. Chesborough, United States.*)
9411. CIRCULAR WICK PETROLEUM SAFETY LAMPS, W. Henley, London.
9412. VERTICAL COMPOUND PUMPING ENGINE, E. E. Clark, London.
9413 ADVERTISING, A. Ward, London.
9414. COLOURING MATTERS, J. Imray.—(*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrer, and D. A. Rosenstiehl, France.*)
9415. SIFTING APPARATUS, H. Simon and T. Voss, London.
9416. EFFECTING AERIAL NAVIGATION, T. Moy, London.
9417. BAGS, W. Dornan and A. D. and W. G. Southgate, London.
9418. VALVE GEAR of STEAM-ENGINES, S. S. Younghusband, London.
9419. TREATMENT of EGGS, J. Tarchan-Mauranoff, London.
9420. MUD GUARDS for BICYCLES, &c., J. J. Bolt, Portsea.
9421. STOPS or GUARDS for CARVING FORKS, A. L. Mora, London.
9422. FILTERS, P. Everitt, London.
9423. IRONING MACHINES, E. L. T. Caron, London.
9424. HOLLOW FIRE-BARS, A. Tolhurst, Gravesend.
9425. SPIRITS, E. J. Taylor, London.
2426. CIGARETTES and SEGARS, G. H. Jones, London.
9427. GUN-CARRIAGE or MOUNTINGS, R. C. Christie, M. Gledhill, and H. H. S. Carington.—(*J. B. G. A. Canet, France.*)

4th July, 1887.

9428. ELECTRIC SAFETY LAMPS, W. Patterson, Durham.
9429. HOLDING DRIVING REINS of CARRIAGES, G. J. Harcourt and E. Shaw, Bristol.
9430. WATCH KEYS, T. D. Harries, Aberystwith.
9431. AUTOMATIC COUPLING APPARATUS, H. Loxley, Sheffield.
9432. NIPPER MECHANISM of COMBING MACHINES, J. McQueen and W. Moores, Manchester.
9433. SECURING PINS in LAGS, A. W. Wood, A. Cowling, and J. Briggs, Bradford.
9434. AUTOMATIC APPARATUS for DRY-CLOSETS, &c , J. Easby, Sheffield.
9435. LATCHES, J. Fox, Birmingham.
9436. SLEEVE LINKS, &c., F. R. Baker, Birmingham.
9437. ROLLER BEARINGS for WRINGING MACHINES, E. N. Kenworthy, Oldham.
9438. BLINDS, W. Allman and G. S. Marshall, Birmingham.
9439. LOOMS, D. and W. A. Crabtree, Bradford.
9440. GUARDS, W. H., S., and C. Sproston, Birmingham.
9441. HEATING FEED-WATER, L. McIntyre, London.
9442. IRONS, G. Browning, Lancashire.
9443. SWITCHES, S. W. Cutriss, Leeds.
9444. ENGINE, J. K. Smithies, Essex.
9445. STORING WATER, R. C. Sayer, Bristol.
9446. GAS ENGINE, J. Middleton, Glasgow.
9447. ROLLING MILLS, W. Bansen, Berlin.
9448. SERVICE CISTERN, H. W. Allan, Glasgow.
9449. AIR-GUN, E. O. Eaton.—(*J. Lancaster, New York.*)
9450. WEIGHING MACHINES, C. W. Blacklock and M. Hynes, London.
9451. IMPROVED FIRE-ESCAPE, S. Osborne and S. Springer, London.
9452. SLIDING WINDOW-SASHES, W. Youlten, London.
9453. CLOSING the BREECH of GUNS, A. Sauvée.—(*J. B. G. A. Canet, France.*)
9454. SPECTACLES, W. F. Stanley, London.
9455. BLOCK-PRINTING, J. C. Cook, London.
9456. CONSUMING SMOKE, J. Willoughby and A. Gledhill, London.
9457. HINGES, S. Hill and R. Hodges, London.
9458. WRITING, &c., T. D. Lichtenstein, London.
9459. LAMPS, S. Biheller, London.
9460. FURNACES, C. E. Hudson, London.
9461. AIR-ENGINES, H. J. Haddan.—(*J. C. Johnson, United States.*)
9462. GUARDS, A. J. Boult.—(*T. D. Smith, United States.*)
9463. REVOLVING FURNACES, H. Schellhaas, Liverpool.

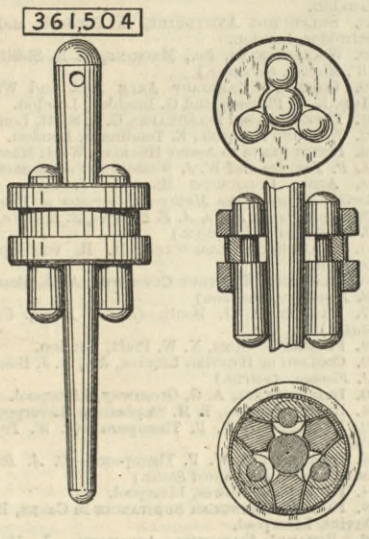
SELECTED AMERICAN PATENTS.

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

361,504. TUBE EXPANDER, *J. A. Giles, Oswego, N.Y.—Filed January 27th*, 1887.

Claim.—(1) In combination with the expanding mandril, the expander body having an axial eye and radial slots, the expanding rollers extending through said slots, keepers seated movably radially in the expander body and bearing against the sides of the respective rollers, and a spring arranged to crowd the keepers toward the axis of the expanding body, as set forth. (2) In combination with the expanding mandril, the expander body having an axial eye, radial slots extending from said eye, an external circumferential groove and mortices extending from said groove toward the axis of the expander body and in

361,504

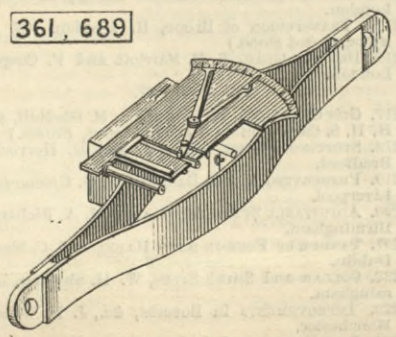


the lines of the radial slots, the expanding rollers extending through said slots and formed with circumferentially-reduced journals inside of the expander body, keepers sliding in the mortices of the body and provided with bearings corresponding to the journal portions of the rollers, and a spring encompassing the expander body in the external groove thereof, substantially as described and shown.

361,689. RECORDING DYNAMOMETER, *C. N Giddings, Massillon, Ohio.—Filed December 13th*, 1886.

Claim.—In a dynamometer, the combination of a spring fitted for tractive attachment a graduated

361,689

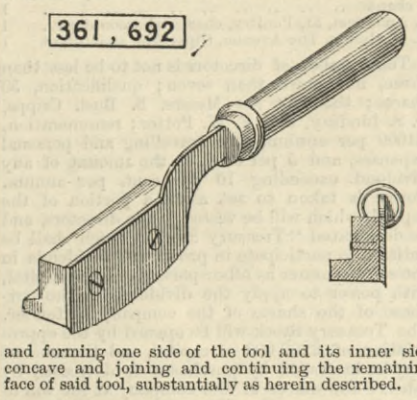


plate, a pivot, a pointer fitted to be oscillated on such pivot by the movements due to strains upon the spring, and an averaging pointer fitted to oscillate upon said pivot and provided with a slot engaged by the first-mentioned pointer, substantially as and for the purpose set forth. In a dynamometer, the combination of spring A, plate B, pointer C, fitted for a pencil, paper drum K, spool N, box G, clock-work disposed within the said box and fitted to revolve the paper drum, guide-finger O, and finger spring M, having a guide plate, substantially as and for the purpose set forth.

361,692. JOINTER for ARTIFICIAL STONEWORK, *G. F. Gray, San Francisco, Cal.—Filed November 11th*, 1886.

Claim.—A jointer for artificial stonework having projecting from one side only of the plane of its face a single knife or cutter, having its outer side straight

361,692

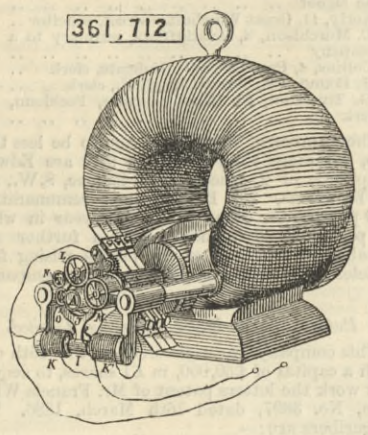


and forming one side of the tool and its inner side concave and joining and continuing the remaining face of said tool, substantially as herein described.

361,712. REGULATOR for DYNAMO-ELECTRIC MACHINES, *C. G. Perkins, Hartford, Conn.—Filed September 18th*, 1886.

Claim.—(1) In a regulator for dynamo-electric machines, the combination, with the armature shaft, of a freely swinging frame, a train of friction wheels mounted on said frame for adjusting the brushes, adjustable resistances, substantially as described, and means operated by a variation of the current generated by the machine for bringing the friction wheels into operative contact with the shaft, as and for the purpose set forth. (2) In a regulator for dynamo-electric machines, the combination, with the armature shaft, of a train of friction wheels for adjusting the commutator brushes, one or more on either side thereof, upon an adjustable frame, an armature connected with the said frame, and two magnets acting on the said armature, one of the said magnets being in the main working-circuit and the other in a shunt around the

361,712

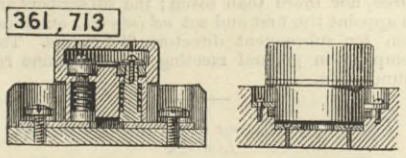


same, as and for the purpose set forth. (3) The combination, with the shaft A and the frame J, supporting the friction wheels L, M, N, and O, the shaft I, pinion R, and rack S, on the collar D, which supports the commutator brushes, of the armature *j* on the frame J, and the magnets K and K¹, as and for the purpose set forth.

361,713. FUSIBLE CUT-OUT, *C. J. Perkins, Hartford, Conn.—Filed September 18th*, 1886.

Claim.—In an electric cut-out, the combination of a base piece for attachments to walls or ceilings provided with circular opening, and internal locking shoulders in said opening, and carrying circuit terminals, con-

361,713

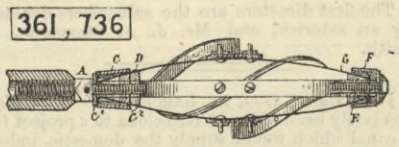


stituting a socket, a plug carrying circuit terminals, and catches corresponding with those in the socket, and recessed to inclose the connecting devices including fusible strip, and a spring for forcing and holding the parts in the locked position, substantially as described.

361,736. FLUE-SCRAPER, *E. D. Weston, Jackson, Mich.—Filed February 26th*, 1886.

Claim.—The combination of the shank A, having screw-threaded portions as described, the tapered thimble C, the washer C¹, the nut C², the spider D,

361,736

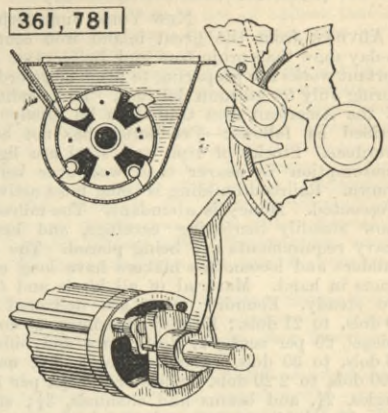


semi-elliptic spring provided with scrapers, the headed screw E, the shouldered conical thimble F, the spreader G, and a set nut, all constructed and adapted to operate substantially in the manner and for the purposes described.

361,781. GRAIN OR FERTILISER DISTRIBUTOR, *B. F. Rix, Kalamazoo, Mich.—Filed February 15th*, 1887.

Claim.—(1) A cylinder revolubly mounted in a grain or fertiliser pocket, provided with periphery recesses, and wings in said recesses having oscillating bearings in said cylinder, substantially as set forth. (2) The combination of a pocket having the circular lower inclosure, a cylinder revolubly mounted therein provided with periphery recesses, wings in said recesses having oscillating bearings and means for swinging the wings to approximately a radial angle, substantially as set forth. (3) The combination of the pocket, a revoluble cylinder therein provided with periphery recesses, oscillating wings having axial bearings in the cylinder, the cranks terminating the end of the wing axles, and a fixed cam having the circular and straight portion, substantially as set forth. (4) The combination of the pocket, a cylinder revoluble therein having periphery recesses, and wings in said recesses, and springs holding said wings at radial angles and adapting them to tilt against a spring resistance, substantially as set forth. (5) The combination, with the pocket, of a cylinder revolubly mounted therein, wings having oscillating bearings in said cylinder, and means for swinging said wings from a radial angle t the plane of the periphery of the cylinder and from

361,781

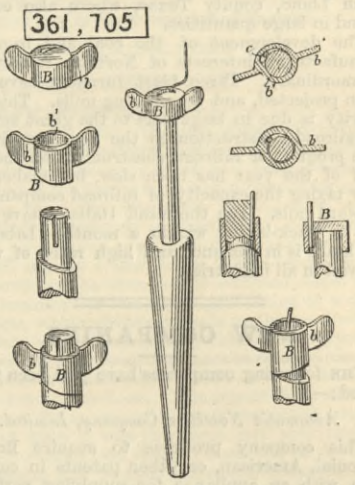


said plane to a radial angle, substantially as set forth.

361,705. BINDING DEVICE for ELECTRIC APPARATUS, *I. W. Litchfield, Warwick, N.Y.—Filed August 16th*, 1886.

Claim.—(1) A binding device for fastening electric wires to zincs and for other similar purposes, comprising the collar B, having the hole *b*¹, the inclined or wedge surface, and the turning extensions *b*, sub-

361,705

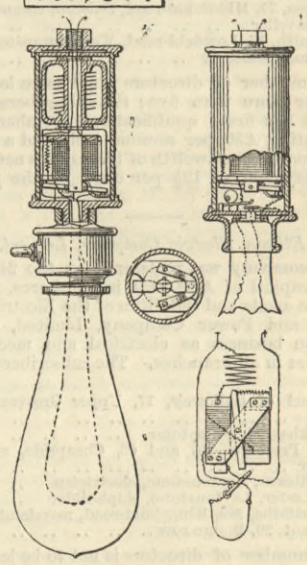


stantially as described. (2) The collar or binding device for electric conductors and other purposes, having the cap, the hole *b*¹, and the hole *c*, having inclined or wedge surface, substantially as described.

361,844. SAFETY DEVICE for INCANDESCENT LAMPS, *E. A. Sperry, Chicago, Ill.—Filed May 22nd*, 1886.

Claim.—(1) The combination, with an ordinary incandescent light-giving lamp and electric circuit wires, of an incandescing resistance lamp comprising an exhausted globe or chamber, a filament offering a greater resistance to the electric current than the light-giving filament, a holder for supporting both lamps, and

361,844

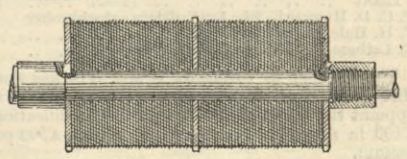


means, substantially as described, mounted upon said holder for establishing electrical communication from one lamp to the other, as and for the object stated. (2) The combination, with an incandescent lamp and a resistance filament in an exhausted flask contained or supported by the same holder, and an automatic switch mechanism to throw the current from one to the other, of a manual switch device operating to connect the circuit to the resistance filament just before it breaks connection with the incandescing filament, substantially as and for the purpose specified.

361,896. ARMATURE-CORE for DYNAMO-ELECTRIC MACHINES, *A. Schmid, Pittsburg, Pa.—Filed July 29th*, 1886.

Claim.—(1) A core for armatures having in combination a series of metallic discs and a series of insulating discs arranged between the metallic discs, the edges of the insulating discs being folded down over the edges of the metallic discs, substantially as set forth. (2) A core for armatures having in combination a series of

361,896



metallic discs and a series of insulating discs arranged to alternate with the metallic discs, the edges of the insulating discs projecting beyond the edges of the metallic disc thereby insuring the perfect insulation of each metallic disc from those adjacent thereto, substantially as set forth. (3) A core for armatures having in combination the retaining discs 3, provided with radially-projecting pin, a series of metal discs 2, and a series of insulating discs arranged between the metal discs, the edges of the insulating discs being folded down over the edges of the metallic discs, substantially as set forth.