STRUTS—THEIR WORKING STRENGTH AND STIFFNESS.

By Professor W. H. Smith.

No. I.

For the sake of convenience in reference we will begin this article by a tabulation of the nomenclature that will be employed.

Nomenclature.

h = the leading cross dimension of the strut perpendicular to the axis of its least cross-sectional moment of inertia, or in certain cases the cross dimension parallel to the known plane of bending.
L = length of strut.
$S = s h^2$ = the cross-sectional area.
$I = i h^4$ = " " moment of inertia.
$I \div \frac{1}{2}h = 2 i h^3$ " " bending modulus.
$W = w S$ = load, where w = average compressive stress on section.
e = the ratio of the excentricity of the resultant end thrust, from the centre of area of end section to the cross-sectional dimension h.
δ = distance of line of thrust from centre of any section when strut is bent by load W. Thus at each end $\delta = e h$.
$M = W \delta$ = bending moment on section.
$m = W \delta \div (2 i h^3)$ = surface stress due to bending moment.
$k = w + m$ = compressive stress on edge of section at concave side of bent strut.
Δ = maximum value of δ generally occurring at middle of length of strut.
$\beta = \pi^2 E \frac{i}{s}\left(\frac{h}{L}\right)^2$

The relations between h, S, and I are very important in whatever manner the subject of struts be treated. The following table sets forth these relations in a form convenient for reference, and for all the shapes of section that are commonly used. In cases III., IV., V., VIII., IX., and X., the plates are supposed to be thin, *i.e.*, the ratio of their thickness to h is taken as small; and certain approximations are made by neglecting the third and higher powers of this small fraction. The error involved in this approximation is so small as to be of no account at all in practice. In cases III., IV., and XI., the strength given by the web, which *necessarily* binds the flanges together, is left out of the calculation, the webs being indicated in the sketches by single lines. The error involved in this neglect is considerably greater than that mentioned above, and should be avoided if accuracy is desired. Account may be taken of the web by combining case II. with III. or IV., and case V. with XI. If the web be a lattice-work, the calculation of strength and stiffness may always be carried out with amply sufficient accuracy as if the same amount of metal actually used in the lattice bars were spread out in a continuous plate web of proportionately less thickness than the actual bars.

IV. is the special case of III., in which the moment of inertia is the same for all possible directions of bending. When the load is *meant* to be centrally applied, and when there are no incidental transverse bending forces, such as wind pressure, it is impossible to say beforehand in which direction the strut is likely to bend, and in this case it is evidently correct to make it as stiff against bending in one direction as in any other; that is, the moment of inertia of the section should be the same round all axes. This is insured by making the section *symmetrical and similar with* respect to two transverse axes at right angles to each other. With the exception of II., III., and VII., all the sections in the table fulfil this condition.

With regard to II., if there be no side forces or known excentricity of thrust to determine the direction of bending, then it is probable, of course, that the bending will take place in the direction of the least cross-dimension, say b. But under the conditions supposed it is improper to have any difference between these two dimensions h and b. The connecting-rod of an engine, or a locomotive coupling-rod, may be taken as a typical case of a strut in which we know beforehand the direction in which the bending would occur if the section were the same as respects two right-angled transverse axes. The friction at the crosshead and crank pins throws the line of thrust away from the centre of section in a determinate plane, and the transverse acceleration of momentum of the rod in the plane of its swinging oscillation supplies bending forces determining the buckling again in the same plane. In these cases it is proper to give the section greater strength in this plane than in the other; that is, it should be made deeper in this plane. Cases II., III., and VII. are intended to supply the formulas suited for such cases, the bending being supposed to take place in the direction of the *greater dimension h*. It should be remarked, however, that if the ratio between the two dimensions be designed with accurate correctness, so as just to allow for the known disturbing influences, it then becomes once more impossible to say beforehand in which plane the buckling in actual work will chiefly occur.

In Section XI. four equal sections are placed at the corners of a square and are braced together by webs. The formulæ apply whatever be the shape of each corner section. The cross-dimension of the corner section must, however, be small in ratio to h, the side of the square, in order that the approximation should not involve appreciable error.

Finally, it may be mentioned that if a section with webs be used, and the webs be neglected in the calculation, some compensation for this neglect may be made by using for h in the formulas the outside dimension, *i.e.*, measured over the outside edges of the flanges, instead of from centre of one flange to centre of the other, as marked in the sketches in the table. This is usually not a full allowance, but it may be really an over allowance if the flanges have considerable thickness.

The reciprocal of the number in the last column is an indication of the suitability of the shape of section for strut duty. Thus it appears that XI. is the best shape, then in order of efficiency come V., VIII., I., VI., X., and lastly IX., which is the section that uses most material for given strength and stiffness.

W being the load, and δ the distance of its line of action from the centre of any section of the strut, the bending moment on that section is $W\delta$, and the edge stress due to that moment is $m = W\delta \frac{h}{2I} = \frac{W\delta}{2ih^3}$. Thus we obtain the fundamental formula for the stress on the edge of any section of a strut—

$$\left.\begin{aligned} k &= \frac{W}{S} + \frac{W\delta}{2ih^3} \\ &= \frac{W}{S}\left\{1 + \frac{s}{2i}\frac{\delta}{h}\right\} \\ &= w\left\{1 + \frac{s}{2i}\frac{\delta}{h}\right\} \end{aligned}\right\} \quad . \quad . \quad . \quad . \quad (a)$$

This is a true formula so long as the stresses are all fairly within the limit of elasticity. It is true for every point of the length of the strut, whether it be of uniform or varied section, whether the load be exactly centred or widely excentric in application, whether the strut be initially straight, or curved, or crooked in any manner, whether the material be uniform in quality or the reverse. It is not true for heavy stresses beyond the limit of elasticity, these being caused by large bending moments, and therefore corresponding with large deflections. The deflection corresponding with this limit increases rapidly with the strut's length and decreases as the thickness increases.

At the section where the deviation from the line of thrust is greatest, the stress at the edge is:—

$$k = w\left\{1 + \frac{s}{2i}\frac{\Delta}{h}\right\} \quad . \quad . \quad . \quad . \quad (b)$$

Δ being that maximum deviation. If the conditions are symmetrical for the two half-lengths of the strut, this section will lie at the centre of the length. If, furthermore, the section be uniform throughout the length, evidently this stress at the centre seetion will be the greatest occurring anywhere. But if the section be varied along the length, in size or in shape, then evidently the maximum stress may or may not occur at the centre, the point at which it actually occurs depending on the mode of variation of the section. By adopting one particular manner of varying it, it would be possible to obtain equal edge-stresses all along the strut.

The first difficulty in utilising this fundamental law for help in practical design is to find out how large Δ is. If we knew Δ it would be comparatively easy to find S, so as to give the desired k. But Δ depends itself on S in a complicated manner, so that the problem becomes involved. The first attempt to formulate the strength of struts was made by Hodgkinson in the shape of a strictly empirical rule to represent the results of his experiments on cast iron and wood columns, the former being solid and hollow cylinders, the latter of solid square section. His rules, which make the strength proportional to a power of the diameter ranging from $3\frac{1}{2}$ to 4 and inversely proportional to a power of the length ranging from $1\frac{3}{4}$ to 2 have, of course, no applicability outside the conditions of the special experiments which he made. They can be found in Molesworth and elsewhere.

Chronologically the next treatment we find of this question is that due to Euler. It is carefully and fully developed in the writings of Redtenbacher and of Grashof. The result given is that anything under a certain load will produce no deflection at all, while anything the least over it will deflect the strut continuously until it breaks. This limit may be expressed by an average stress per square inch by dividing the limiting load by the section. Thus expressed it is:—

$$\text{Limiting average stress per sq. in.} = \beta = \pi^2 E \frac{i}{s}\left(\frac{h}{L}\right)^2 \quad (c)$$

It is here termed β because that letter has been used for the same quantity by Professors Ayrton and Perry in the columns of The Engineer of 10th and 24th December, 1886. The actual safe average stress w in struts is always greatly less than this unless the length be very short, when the piece ought to be called rather a "bearing block" than a "strut." This rule applies only to struts of uniform section. It is deduced from the assumptions that the strut is initially perfectly straight, perfectly homogeneous in quality; that excentricity of the thrust from centre of end section is avoided with absolute mathematical exactness; and that the stress indicated by this formula lies within the limit of elasticity. For struts of ordinary proportions the last assumption is far from the truth. Again, some small accidental inexactitude in the centreing of the load must be reckoned on in practice,

Table of Values for Strut Sections.

Shape of section.	S.	s.	I.	i.	$\frac{2I}{h}$.	$\frac{s}{2i}$.	Remarks.
I.	h^2	1	$\frac{1}{12}h^4$	$\frac{1}{12}$	$\frac{1}{6}h^3$	6	Square.
II.	bh	$\frac{b}{h}$	$\frac{1}{12}bh^3$	$\frac{1}{12}\frac{b}{h}$	$\frac{1}{6}bh^2$	6	Bending ‖ h.
III.	$2bt$	$2\frac{bt}{h^2}$	$\frac{1}{2}bth^2$	$\frac{1}{2}\frac{bt}{h^2}$	bth	2	Thin flanges. Bending ‖ h.
IV.	$6th$	$6\frac{t}{h}$	$\frac{3}{2}th^3$	$\frac{3}{2}\frac{t}{h}$	$3th^2$	2	Thin flanges. I equal round all axes.
V.	$4th$	$4\frac{t}{h}$	$\frac{2}{3}th^3$	$\frac{2}{3}\frac{t}{h}$	$\frac{4}{3}th^2$	3	Thin plates.
VI.	$\frac{\pi}{4}h^2$	$\frac{\pi}{4}$	$\frac{\pi}{64}h^4$	$\frac{\pi}{64}$	$\frac{\pi}{32}h^3$	8	Circle.
VII.	$\frac{\pi}{4}bh$	$\frac{\pi}{4}\frac{b}{h}$	$\frac{\pi}{64}bh^3$	$\frac{\pi}{64}\frac{b}{h}$	$\frac{\pi}{32}bh^2$	8	Ellipse.
VIII.	πth	$\pi\frac{t}{h}$	$\frac{\pi}{8}th^3$	$\frac{\pi}{8}\frac{t}{h}$	$\frac{\pi}{4}th^2$	4	Thin tube.
IX.	$2th$	$2\frac{t}{h}$	$\frac{1}{12}th^3$	$\frac{1}{12}\frac{t}{h}$	$\frac{1}{6}th^2$	12	—
X.	$3{\cdot}4th$	$3{\cdot}4\frac{t}{h}$	$\cdot175th^3$	$\cdot175\frac{t}{h}$	$\cdot35th^2$	9·75	Thin plates. Inside diagonal, $\frac{1}{2}h$.
XI.	S	$\frac{S}{h^2}$	$\frac{1}{4}Sh^2$	$\frac{1}{4}\frac{S}{h^2}$	$\frac{1}{2}Sh$	2	Corner sections of any shape, but all equal and small in ratio to h.

and, unfortunately, a very minute excentricity has an extremely large influence in reducing the strength of a long strut. This formula is thus known to give extravagant results in practice, and is not of real utility in engineering design.

The next effort that may be mentioned is embodied in what is known as Lewis Gordon's formula. It is recommended by Rankine, who worked out a set of coefficients to be used in it for several different shapes of sections. To compare it with our fundamental formula, it may be written

$$k = w\left\{1 + a\,\frac{s}{i}\left(\frac{L}{h}\right)^2\right\} \quad . \quad . \quad . \quad (d)$$

where a is a coefficient depending on the shape of section and modulus of elasticity of the material. Mr. Shaler Smith has worked out a large number of coefficients for this rule, which may be found in Molesworth.

This rule is deduced in the following way:—In the pure cross-bending of beams for each shape and mode of variation of section and each mode of distribution of load, the deflection that co-exists along with any maximum edge stress m is proportional to $\frac{m}{E}\frac{L^2}{h}$. If m be taken as a FIXED constant quantity considered *safe* for the material, this gives the "safe deflection" proportional to $\frac{L^2}{h}$. This result, which is perfectly correct for beams subject to pure bending only, is applied to struts by taking $\triangle$ in law (b) proportional to $\frac{L^2}{h}$, whence is immediately obtained the above formula (d). To recognise at once that the application is wrong and inconsistent with itself, it is only necessary to notice that it assumes m as a fixed constant quantity in the equation $k = w + m$. What really ought to be constant is k, the maximum stress in the strut. If k and m be constant, then $w = \frac{W}{S}$ would also be constant; and to find the proper S, one would need to do nothing but divide the load W by the constant w. But the rule (d) itself does not give w constant for constant k; and besides, common experience shows that w ought to decrease rapidly with the length. The true logical result of the above reasoning is the formula

$$k = w\left\{1 + a^1\,m\left(\frac{L}{h}\right)^2\right\}.$$

In this it is just as involved a problem to determine m as it is to find $\triangle$ in equation (b), and there is, besides, the difficulty of finding the correct factor a^1 for each set of conditions. If the rule were consistent with itself, it might be accepted as a rough empirical approximation to experimental results, but as it is not so, it is necessarily discarded as worse than useless, namely, provedly misleading.

Next in chronological order may be mentioned a paper written in May, 1877, by the present writer, read before the Edinburgh and Leith Engineers' Society on 20th March, 1878, and printed in the proceedings for 1877-78. In this the fallacies underlying the above two rules were explained in detail, and the effect of excentricity of application of the load was shown to give formulas equivalent to the following:—

$$\left.\begin{aligned} \triangle &= e\,h\,\sec.\left(\frac{\pi}{2}\sqrt{\frac{w}{\beta}}\right) \\ k &= w\left\{1 + \frac{s}{2\,i}\,e\,\sec.\left(\frac{\pi}{2}\sqrt{\frac{w}{\beta}}\right)\right\} \end{aligned}\right\} \quad . \quad . \quad (e)$$

These formulæ apply only when the section is uniform throughout the length. Methods of using this formula for the practical work of design were explained, and a series of curves drawn to facilitate such work. It was shown that the excentricity e may be due to "imperfection of workmanship," "want of elastic homogeneity in the material," and journal "friction," occurring, for instance, in the cases of connecting rods and excentric rods. The probable relative values of this excentricity in struts of different materials, different forms of end jointing, different lengths, sizes and shapes of section, were discussed at length. The general conclusion arrived at was that, under given loading, the "maximum stress upon a strut is a perfectly definite quantity; but that, since it depends on the magnitude of the excentricity of application of the load, and since this excentricity—although in an absolute sense strictly determinate in each special case—is not capable of accurate calculation, therefore the whole question of the strength of struts is one of probability and not of exact theory."

There may be next mentioned a paper by Mr. Claxton Fidler, published in the "Proceedings" of the Institute of Civil Engineers, vol. lxxxvi., year 1886, evidently written without a knowledge of the last-named paper. Here, again, excentricity of line of pressure is considered to be the determining cause of weakness in struts. The excentricity due to want of homogeneity is taken as the leading influence, and its possible amount is calculated from the range of modulus of elasticity shown in experiments on several materials. The formula used is deduced from the case of a strut the load on which is centred with exactitude at both ends, but which is slightly bent before being loaded, the initial curve being taken as a curve of sines. The rule given by Mr. Fidler is:—

$$k = w\left\{1 + \phi\,\frac{w}{\beta - w}\right\} \quad . \quad . \quad . \quad . \quad (f)$$

where ϕ is proportioned to the ratio of the excentricity due to inequality of elasticity to the cross-dimensions of the section. There seems, however, to have occurred some mistake in the deduction of this equation, as it seems impossible to reconcile it with (g) below, which has been obtained independently by others of acknowledged mathematical ability and by the present writer.

To compare more clearly with previously mentioned formulas the result of supposing exact end centreing and initial strain according to a curve of sines, we may put $\epsilon\,h$ = initial central deflection—before loading. Then we find:—

$$\left.\begin{aligned} \triangle &= \epsilon\,h\,\frac{\beta}{\beta - w} \\ k &= w\left\{1 + \frac{s}{2\,i}\,\epsilon\,\frac{\beta}{\beta - w}\right\} \end{aligned}\right\} \quad . \quad . \quad . \quad (g)$$

This formula does not require reference to trigonometrical tables; but the numerical examples given below show that this leads to no practical advantage.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

Portugal—New Customs Tariff.—Articles free of import duty, but subject to the tax of 2 per cent. *ad valorem*, for works in bars or harbours:—Brass, bronze, copper, &c., in castings or sheet; iron shot; lead, pewter, and zinc, in castings, sheet, and shot; metals not manufactured, not otherwise specified; mineral ore; minerals in the rough, not classified; miners' fusees; vessels navigable or new, exceeding 7065 cubic feet, and steam tugs with a gross tonnage exceeding that amount.

CLASS VII.—*Mineral Substances.*

	£ s. d.
Coal and coke .. .. per ton	0 1 5½
Minerals manufactured.. .. .. *ad val.*	3 per c.

CLASS VIII.—*Metals.*

	£ s. d.
Copper, mixed or pure, with brass, bronze, &c., in basins, unfinished .. .. per ton	7 18 2
Copper, pure, or mixed with brass, bronze, &c., hammered or not otherwise mentioned, and tubing.. .. .. .. per ton	2 5 0
Copper, pure, or mixed with brass, bronze, &c., wire drawn .. .. per ton	18 1 7
Iron, cast in lumps or sheets, not manufactured .. *ad val.*	4 per c.
Iron, in lumps or sheets, galvanised, tinned, covered with lead or zinc, painted, plain, or prepared in any way, per ton	0 13 7
Iron, manufactured, not otherwise mentioned, painted or rough .. .. per ton	9 9 10
Iron, manufactured, not otherwise distinguished, enamelled, gilded, polished, varnished, &c. .. .. per ton	19 4 2
Iron manufactures, not otherwise classified, exceeding 220·4 lb. in weight .. .. per ton	2 5 2
Iron manufactures, wire drawn.. .. .. per ton	15 16 5
Iron rails of any description .. .. per ton	12 8 6
Iron tubing .. .. per ton	3 7 10
Iron, wire drawn .. .. per ton	0 13 7
Iron, wrought or in tubes .. .. *ad val.*	4 per c.
Iron, wrought cables and chains, not otherwise specified .. .. per ton	3 7 10
Iron, wrought manufactured, not otherwise classified, painted or rough .. .. per ton	24 8 2
Iron, wrought, enamelled, gilded, polished, varnished, &c. .. .. per ton	45 2 0
Iron, wrought, not otherwise specified, each article weighing over 220·4 lb.. .. .. per ton	12 19 6
Lead, manufactured .. .. per ton	51 19 7
Metals not elsewhere classified, manufactured, pay the same duties as copper.	
Sheathing nails .. .. per ton	6 15 7
Steel, cast, not otherwise mentioned .. .. *ad val.*	4 per c.
Steel, manufactured, not elsewhere specified .. .. .. per ton	54 4 10
Steel springs for vehicles .. .. per ton	6 15 7
Steel wire .. .. per ton	15 16 5
Tin, manufactured.. .. .. per ton	13 11 2
Zinc, manufactured, perforated or in sheets, for buildings, per ton	6 2 5
Zinc, manufactured, not elsewhere classified .. .. .. per ton	13 11 2

CLASS X.—*Apparatus and Machinery Employed in Agriculture, Industry, and Science.*

	£ s. d.
Copper apparatus for distilling and concentration in vacuo, per ton	11 6 0
Implements and tools for agricultural and gardening purposes, per ton	0 18 10
Implements and tools and separate pieces of machinery for industrial purposes .. .. per ton	1 2 7
Ditto, pieces for industrial purposes and for steam engines not otherwise mentioned	5 13 0
Machinery, industrial, not elsewhere distinguished .. per ton	3 7 10
Steam machinery up to 15-horse power .. .. per ton	4 10 5
,, ,, 50 ,, ... per ton	3 7 10

CLASS XII.—*Miscellaneous Articles.*

	£ s. d.
Anchors, chains, and other articles of metal for fishing and sailing purposes .. .. per ton	2 14 3
Fixed and rolling stock for railways of any kind .. *ad val.*	10 per c.
Sailing or steamships new or ready for use up to 7065 cubic feet, *ad val.*	12 per c.
Vehicles of all kinds except railway carriages .. .. *ad val.*	27 per c.
Vessels condemned as unseaworthy, on the sale price *ad val.*	7 per c.

Portugal—Completion of Harbour Works at Azores.—Tenders for the completion of the harbour works at Ponta Delgada in the Island of St. Michaels will be received up to 2 p.m. on 21st November next. No tender is admissible unless the persons sending it shall previously deposit £14,444, either in cash or in Portuguese bonds of the Public Debt. Up to the 21st November the whole of the designs, plans, sketches, &c., as well as various documents concerning the work, may be examined at the Department of Public Works, Lisbon, and at the office of the harbour Works at Ponta Delgada.[1]

Russia—Opening of Ochakoff Canal.—The Ochakoff Canal, or the newly deepened channel in the Ochakoff bar, was opened on the 18—30th July last. The length of the channel dredged is 4¼ miles; the width, from 350ft. to 385ft. The depth of the channel has been increased from 16½ft. to 20ft. With a strong northerly wind the water falls considerably; the Russian Government intends increasing the depth to 22ft. or 23ft., and dredging the shallows at the mouth of the Bougat to the same. The quantity of deposit removed was 1,027,361 cubic yards, at a cost of £90,230.

Tahiti—Trade in 1887.—There has been very little change in the state of trade here for the past half-year, and there are general complaints from merchants at the general decrease of trade in these islands. No official list of imports for 1886 has yet been published, without which the true value of British manufactured goods imported cannot be exactly arrived at—in addition, many articles come through Bordeaux, Hamburg, and San Francisco. In round numbers the relative proportions of imports of different national productions may be taken at:—American, 40 per cent.; British, 20 per cent.; French, 17 per cent. Among the principal articles of British production are galvanised iron for roofing, nails, copper, iron, yellow metal and nails for sheathing vessels. There are not any complaints as to the execution of orders or the quantity of British goods, which may be accounted for by the agents in England who buy for the market being generally well posted in the trade requirements of Tahiti. It is not probable that there will be any great extension of British trade with these islands; but unless some prohibitive legislation, such as was proposed by the last Conseil-General, comes into force, there will always be as much demand for English goods as at present. The Colonial Government having reduced the subsidy for carrying the mails to and from San Francisco, cannot get any one to perform the service; we are, therefore, in unpleasant uncertainty as to how or when our despatches will be forwarded or mails received. A subsidy of £6000 a year would insure the service of a regular line of steamers from and to San Francisco. The Colonial Government seem to be waiting for the opening of the Panama Canal, when they will endeavour to make postal arrangements with the Home Government in connection with the existing service between France and Colon.

Tunis—Report on forests.—The forests of Tunis, which cover an appreciable part of the surface of the country, were, until the French occupation, subject to no supervision, and suffered much from the want thereof. In 1883, the French, alive to the importance of preserving the remnant of these forests, which are the property of the State, placed them under the management of a separate department, which has carefully explored their extent, and conclusively demonstrated that they are an important element of national wealth. It is to the cork forests that the attention of the new department has been mainly directed. In dealing with the forests and woods three systems were proposed—concession for fixed periods, management by the State, or sale. The second of these was adopted as the system best adapted for their extension and preservation, especially as it was held to be of paramount importance to favour the increase of rainfall in the country, the quantity of which is supposed to be intimately connected with the forests. Much has been done during recent years in improving the condition of the cork forests. Roads have been cut through them, and spacious alleys formed at stated intervals to serve as a means for arresting the march of the destructive fires which frequently ravage them. Above all, much progress has been made in barking the trees, by stripping the rough bark from the trunks of the trees to the height of 5ft. or 6ft. from the ground. To meet the expenses incurred, there were available the sums accruing from the sale of the trees already felled, and of the bark of the zen for tanning. The Director of Forests and Woods has drawn up an estimate of the expenses and receipts of his department for three consecutive decennial periods commencing with 1884. He estimates that during the third decennial period 1904—1914 the expenditure per annum will be £27,000, and the receipts £96,000, leaving a yearly profit of £69,000. A map showing position of forests accompanies report.

Brazil—Trade of Rio Grande do Sul.—The U.S. Consul at Rio Grande do Sul in a report on emigration says:—A number of English and German mechanics find employment on the lake, ocean, and river steamers, and in the railroad shops, but they generally arrive under contract for a stipulated term of years, subject at the expiration to a renewal, with an increase of wages, if they desire to remain. The trade of this province, formerly controlled by the English, has of late years gradually passed into the hands of the Germans, where it is likely to stay, as there are no people who can compete with their Jewish business acumen, love of money, and shoddy of goods.

Colombia—Prosperity of British trade.—The U.S. Consul at Barranquilla reports:—Columbians will not purchase from American manufacturers, as they can purchase the same goods from English manufacturers at from 30 to 40 per cent. less, especially in machinery of all kinds, except agricultural implements and tools, mining machinery, and pumps. Within the next five years not less than a hundred cities in South America will establish waterworks, all the material for which will be furnished by England. Large works are now being constructed at Bogota, the capital of the country; all the material used comes from England in English vessels, and is landed at this port. Speaking to the contractor recently, while looking at the material being put on river steamers—mostly built in England—I told him that the United States could furnish better pipes than those he was shipping. He replied, "I know it; but these are good enough for all purposes, and 35 per cent. cheaper than any I priced in the States." There is not a locomotive or railroad car of American make; all are English, though the owner of the railroad is an American. All the rails are English. It may be safely estimated that within the next twenty-five years not less than 50,000 miles of railway will be constructed in South America. English manufacturers will furnish all the materials for these vast undertakings, unless our manufacturers are willing to compete with them upon the merits of their wares alone. An English syndicate of iron manufacturers—the same that has operated so successfully in Chili during the last few years—has just purchased a 200 miles railroad concession in this country, and thus the industry of their manufacturers thrives, and a market is made for their goods by their intelligent business methods. Why cannot our manufacturers do the same? If English capital controls the railroad system of this continent, as it is in a fair way of doing, the same capital will control all the commercial and industrial avenues of this vast and extremely rich country—second to no other in natural resources of all sorts.

Germany—Thomas slag as a fertiliser.—The U.S. commercial agent at Mayence sends an elaborate and exhaustive report upon the extending use of Thomas slag as a fertiliser of great value to those interested in agriculture and in disposing of the slag. The refuse obtained in the working of crude iron, which was formerly considered waste to be got rid of in the best possible way, is now regarded in Germany as a valuable fertilising agent, and an excellent substitute for superphosphates. At present about 400,000 tons are ground into powder and used on the fields. Thomas slag is rich in phosphoric lime, from which the iron is separated, and the slag then ground into dust, meal, or powder, and put on the market as a fertiliser under the name of patent phosphate meal, containing from 24 to 28 per cent. of phosphoric acid. It was considered until recently that this dust, meal, or powder could not be used as a fertiliser through not dissolving easily enough. Closer study has led to the conclusion that it is more efficient than bone dust or Peruvian guano, and can be sold to the farmers at one-third the price of superphosphate, containing an equal quantity of phosphoric acid. Professor Wagner, in charge of the Governmental experimental agricultural office at Darmstadt, has carried out a series of experiments to fix the relative value of Thomas slag in comparison with other fertilisers, and published a treatise on the subject, upon which the report is based. The result of these experiments was, the fertilising value of phosphoric acid in superphosphate, when soluble in water, being fixed at 100:—

Superphosphates	100
Raw Peruvian guano..	39
Steamed bone dust	10
Coprolithenmehl	9
Thomas slag, first quality	61
,, ,, medium	58
,, ,, coarse	13

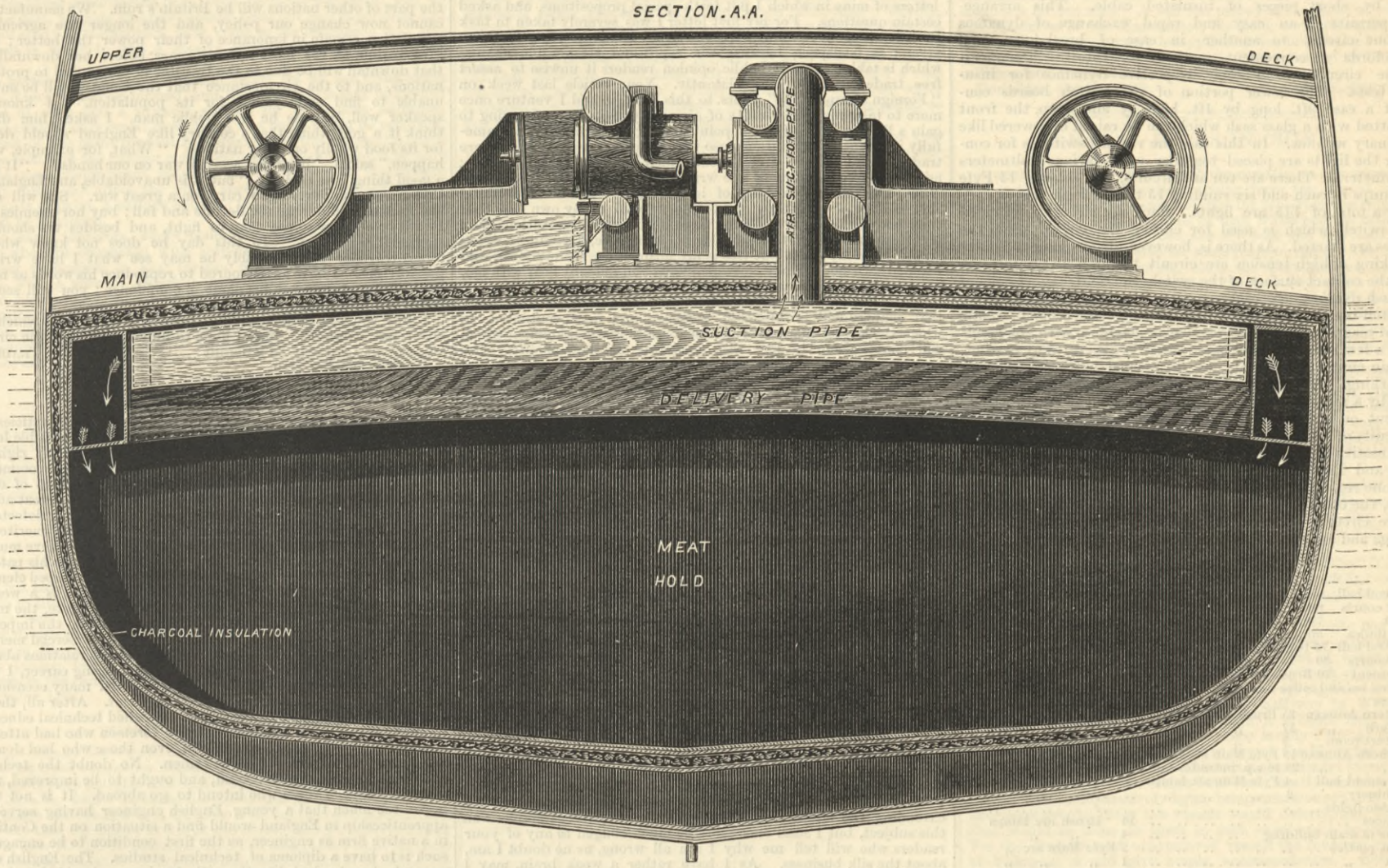
For all practical purposes a mixture composed of 20 per cent. of coarse and 80 per cent. of fine powder has a fertilising value of 50, which is sufficient. Superphosphate costing 100 and Thomas slag ·45, the use of the latter effects a saving of 10 per cent. The report contains a full description of the experiments, diagrams, illustrations, methods of application, tables, &c.[2]

[1] See ENGINEER, 2nd September, 1887, p. 188.

[2] U.S. Consular Reports, 81, 1887, pages 1—11.

REFRIGERATING MACHINERY, S.S. FIFESHIRE.

MR. T. B. LIGHTFOOT, LONDON, ENGINEER.

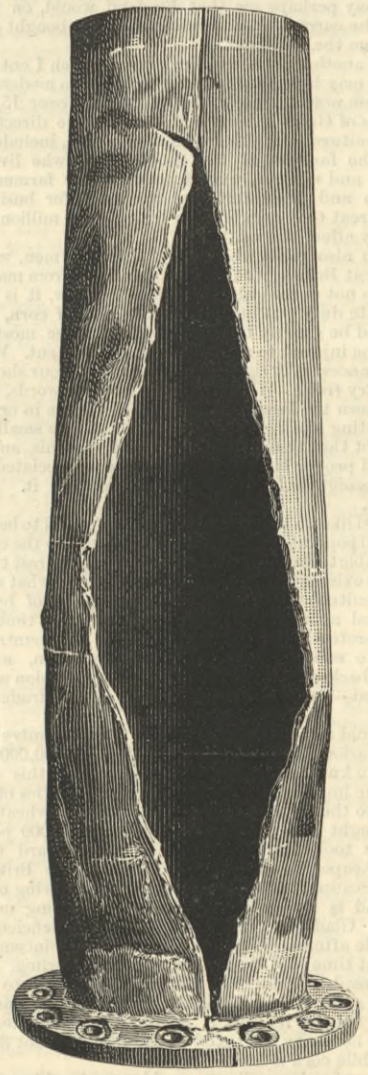


REFRIGERATING MACHINERY FOR THE S.S. FIFESHIRE.

On Wednesday, the 5th inst., a number of influential gentlemen interested in the frozen meat trade were invited to an inspection of the refrigerating machinery on board the s.s. Fifeshire, recently built by Messrs. Swan and Hunter, Wallsend, for Messrs. Turnbull, Martin, and Co., Glasgow, under the survey of Mr. John Wotherspoon, of Greenock. This vessel has been specially designed and built for the New Zealand meat trade, and embodies the latest improvements in marine engineering and architecture. The engines are by Messrs. Blair and Co., of Stockton, and are of the triple expansion type for working with steam of 160 lb. initial pressure. The coal consumption will only be 20 tons per day, which is remarkably low for a vessel carrying 5000 tons at a speed of eleven knots per hour. The fore hold is entirely fitted out for meat carrying, and is insulated in the usual manner with flake charcoal between two layers of tongued and grooved boards. Practically the whole of this hold is below the water level, so that it is not exposed to the direct rays of the sun. This is shown in the section above. The net capacity, after deducting insulation, air trunks, &c., is about 84,000 cubic feet, which is equal to the carrying of some 30,000 carcases, or about 900 tons, of frozen mutton. The cold air is admitted by a large wood trunk extending along one side, and is withdrawn by a similar trunk at the other side. The cooling machinery, which is said to be the most powerful of the kind ever applied to ship work, has been designed by Mr. T. B. Lightfoot, Queen Victoria-street, E.C., and supplied by Messrs. Siebe, Gorman, and Co., Westminster Bridge-road. It is illustrated by two views on page 312, and consists of two patent "Universal" dry air refrigerators, each capable of delivering 80,000 cubic feet of cold air per hour, with an independent surface condenser common to both. The machinery is placed in the 'tween decks, above the meat hold, in a large, well-lighted room. The air is drawn from the hold, and compressed to about 45 lb. per square inch in a double-acting compression cylinder, in which operation, though the cylinder is water jacketted, it becomes considerably raised in temperature. It is then passed through welded steel coolers contained in the bed-plate, and cooled by means of water circulated by a pump to within a few degrees of the temperature of the sea. After this the cooled compressed air is led to the expansion cylinder, where it is expanded, in the performance of work, to atmospheric pressure, and discharged direct into the trunk, cooled to from 60 deg. to 80 deg. below zero, Fah., according to the temperature of the cooling water. The compression and expansion cylinders are arranged tandem fashion, with one piston-rod common to both. The driving power consists of a compound tandem steam engine with the low-pressure cylinder in front, placed alongside the air cylinders, and upon the same bed-plate. The steam, which has an initial pressure of 160 lb. per square inch, is expanded twenty times. Great care has been taken in the design of these machines. They are got up in the latest style of best marine practice, and the materials employed have been carefully selected. One of the special features is the extreme simplicity of the apparatus, and consequent freedom from liability to get out of order, and the makers state that, out of the fifty or more machines supplied, there has not been a single instance of a breakdown. It was chiefly on this account that Mr. Wotherspoon, the superintending engineer, recommended the adoption of this type of machine for the Fifeshire, and from the inspection there seems every prospect that he will not be disappointed. The two refrigerators are placed athwartship, as will be seen by the plan of the general arrangement of the plant. After the lunch, at which Mr. Edward Martin presided, the usual toasts were given, Sir Saul Samuel, Agent-General for New South Wales, Sir James Garrick, Agent-General for Queensland, Mr. Adye Douglas, and others, responding.

BURST STEAM PIPE, S.S ELBE.

The accompanying engraving has been carefully reduced from a very good photograph by Messrs. Adams and Scanlan, of Southampton. The pipe gave way close to the brazed seam. The flange appears to have begun to give way as well as the pipe, the fracture entering into it as shown in the engraving. The article on the explosion, in a recent impression, contains an outline engraving of the pipe, but the above gives a better idea of its appearance, though we cannot speak upon it until the result of tests are made known.



THE ELECTRIC LIGHT AT THE ADELAIDE JUBILEE INTERNATIONAL EXHIBITION, 1887.

Our South Australian cousins, who are this year celebrating the jubilee of their colony in the form of an International Exhibition at Adelaide, decided upon the use of electricity for illuminating the buildings and grounds. That their decision was a wise one has been amply proved by the large attendance during the evenings, as the number of admissions has exceeded by many times the population of that fair city. These large attendances are no doubt to a great extent due to the bright and cheerful appearance the electric light gives to a large building.

The promoters of the Exhibition having called for tenders for lighting the Exhibition buildings, to which several electrical firms responded, a tender from the Australasian Electric Light, Power, and Storage Company, of London and Sydney, was accepted, and a contract entered into with the above company for supplying 140 arc lamps and 210 incandescent lamps. Although not a very extensive installation when compared with some of those we are used to see on this side of the globe, it is by far the largest arc light installation that has up to the present time been attempted in Australasia. The motive power for driving all the electric light plant is supplied by Messrs. Robey and Co.'s steam engines, through their agents, Messrs. Harrold Brothers, of Adelaide, which firm are also the sole agents for South Australia for the Australasian Electric Light, Power, and Storage Company. The following account of the installation may prove of interest to our readers.

The plant which is located at the south-east corner of the machinery hall covers an area of 80ft. by 60ft.; the space is neatly railed off, so as to permit of a thorough inspection, but at the same time keeping onlookers at a safe distance from the numerous pulleys, belts, and dynamos. The electric plant comprises ten No. 7a Brush arc dynamos, each of 8000 Watts capacity; one No. 6 convertible Brush arc dynamo of 6000 Watts capacity. This machine can, by means of an ingenious switch, be made to give a current of 10 ampères and 600 volts, or 20 ampères and 300 volts, which makes it a very useful machine for charging accumulators when not employed for working arc lights. The incandescence plant comprises three C^2 Brush Victoria dynamos, each of 8000 Watts capacity; one Edison-Hopkinson dynamo of 7800 Watts; and one Edison dynamo of 5000 Watts.

The dynamos are fixed in two parallel lines and secured to heavy baulks of Oregon timber, which are securely bolted to transverse sleepers buried in 3ft. of concrete. As the space at the company's disposal was very limited, somewhat short belts had to be used for driving the dynamos, the belts having in consequence to be kept well stretched, a dynamo is provided with a substantial belt-tightening arrangement. The dynamos are driven from a line of countershafting 70ft. in length by 4in. diameter, supported on substantial wooden trestles. To avoid the risk of a total failure of the light due to an accident to an engine or dynamo the shafting is cut into several sections, each section driven respectively by the following steam engines of Messrs. Robey and Co.'s manufacture, viz., one 16-horse power nominal portable engine, one 20-horse power nominal portable engine, one 20-horse power nominal compound semi-fixed engine fitted with automatic expansion gear, one 16-horse power nominal semi-fixed engine, one 12-horse power nominal semi-fixed engine, and one 30-horse power nominal horizontal engine fitted with Dr. Prôell's patent automatic expansion gear.

The cables from each of the dynamos are conveyed underneath the flooring—which is constructed so as to form a shallow wooden trough with cover—to a somewhat elaborate switch board, from which all the lights in the building are controlled. The upper portion of the switch board consists of a cupboard with two doors, inside of which are arranged two rows of ter-

minal binding screws. The lower row is connected directly to the terminals of the various dynamos, while of the upper row twenty are connected to the various leads and return cables of the arc circuits, and ten to the lead and return cables of the incandescent circuits. All the terminals are lettered and numbered, the positive being lettered in red and the negative in blue. The dynamo terminals are connected to the circuit terminals by short pieces of insulated cable. This arrangement permits of an easy and rapid exchange of dynamos from one circuit to another in case of breakdown, and also affords a convenient method for totally disconnecting the circuits from their respective dynamos for insulation tests. The lower portion of the switch boards consists of a case 9ft. long by 4ft. high by 9in. deep, the front being fitted with a glass sash which can be raised or lowered like an ordinary window. In this case the various switches for controlling the lights are placed together with various voltmeters and ammeters. There are ten arc circuits, four having 13 Fyfe Main lamps in each and six running 15 to 16 Brush lamps, each making a total of 145 arc lights. Each arc circuit is provided with a switch, which is used for closing the circuit when the dynamos are started. As there is, however, always some difficulty in breaking a high-tension arc circuit through an arc forming across the contact surface of the switch, the field magnet coils of the Brush dynamo are each connected to a separate switch on the switch-board. This switch, upon being closed, short circuits the field magnet coils of its particular machine, with the result that in a few seconds the dynamo ceases to generate any current. The main circuit switch can now be opened without, of course, any sparking. Each of the incandescence light circuits is controlled by a main switch, and is also provided with the usual safety cut outs. Cardew's patent voltmeters are connected to the circuits of each of the incandescent dynamos, so that the electro-motive force can be observed and kept steady. Two of Ayrton and Perry's direct-reading spring voltmeters are provided, one registering from four to twenty ampères for the arc circuits, the other registering up to 200 ampères for the incandescence circuits. The lights are distributed on the various buildings and annexes as follows, viz.:—

Main building.		Floor space. Square feet.
Central hall,	9in. Fyfe Main arc lamps illuminating ..	12,750
East courts	8in. „ „ „ ..	9,000
West „	7in. „ „ „ ..	9,000
Vestibules	5in. „ „ „ ..	6,900
Central hall	72 16-candle power incandescent lamps ..	6,350
Art courts	80 „ „ „ ..	7,400
Basement	20 Brush arc lamps illuminating	15,360
Ladies' tea and coffee-room	22 16-c.p. incandescent lamps	1,300
Offices	9 „ „ „ ..	
Western Annexe	35 Brush arc lamps illuminating	86,000
Eastern „	12 „ „ „ ..	35,000
Concert-room	3 „ „ „ ..	
Northern Annexe	13 Fyfe Main arc lamps	33,600
„ „	28 16-c.p. incandescent lamps	4,200
Armament hall	4 Fyfe Main arc lamps	7,600
Machinery	2 „ „ „	
Outside lights		
Terraces	16 Brush arc lamps	
Dome of main building	4 „ „	
Front portico	2 Fyfe Main arc „	
Back „	1 „ „ „	

Making a total of 141 arc lamps and 211 incandescent lamps. There are also several arc and incandescent lamps supplied to some of the exhibitors, which brings the total up to 145 arc and 266 incandescent lights. About eight miles of cable have been used for running the various circuits, which have been arranged, as far as possible, so that no particular building is lighted entirely from one dynamo, so that in case of a breakdown the place would not be plunged into total darkness.

All this machinery has now been working for the last two months and giving every satisfaction, and reflects great credit on all parties concerned.

NEW FORM OF DREDGER FOR REMOVAL OF ROCKS IN THE SUEZ CANAL.

A new form of dredger and excavator for dealing with rock bottoms was launched on the 5th inst. from the yard of Messrs. Lobnitz and Co. at Renfrew. It is named the Dérocheuse, and is intended to inaugurate a new and simple method of excavating subaqueous rocks. She is very powerful and strongly built, and embodies a novel principle in rock breaking which was invented by Mr. H. C. Lobnitz as a solution of the difficulty of widening and deepening the Suez Canal at the Suez end, where about three millions of tons of hard rock will have to be removed. Instead of using the ordinary system of boring holes in the rock under water, and breaking up the rock by means of explosives, the work is done by means of heavy blows with long chisel-shaped cutters. These cutters weigh each about four tons; and when dropped a distance of, say, twenty feet they break up and dislodge the rock in a most thorough fashion, ready for removal by dredging. This has been demonstrated by various dry land trials with these cutters on some of the hardest rock to be met with in Scotland. The cost of excavating and removing rock by the blasting system when working at, say, 30ft. under water may be twenty shillings per cubic yard. With the new system, of which the Dérocheuse is the pioneer representative, it is expected that four shillings per cubic yard will easily cover the cost of breaking the rock and raising and carrying away the *déblais*. Various trials were carried out from March to September of this year at Craigmillar Quarry, Edinburgh. The result of the last trial showed an average of over six cubic feet of rock dislodged for each blow of the cutter. This was more than was expected by the patentee, and caused considerable surprise to those present. Similar results were attained at the other trials already referred to. The lowest average result was about four cubic feet per blow of the light cutter used, and when the very hard nature of the rock at Craigmillar Quarry is considered, even this is a surprising result; but with the heavy cutters fitted for the present purpose, it is thought more than double that effect will be insured. The dimensions of the Dérocheuse are:—Length, 180ft.; breadth, 40ft.; depth, 12ft.; and she is divided into eighteen watertight compartments. She has machinery on board of a total indicated power of over 1000 horses, including hydraulic engines and rams for working the ten rock-cutters, which are each 45ft. in length. For these, ten 6-ton hydraulic hoists are provided, capable of lifting to a height of 60ft., and working with a pressure of 1000 lb. per square inch. By means of a set of levers one man can manœuvre the whole rock-breaking apparatus without moving from his post, everything being self-acting and simple.

Taking the year's coal production in the United Kingdom at 160,000,000 tons, the following are the estimated quantities used in different ways:—Paper making, 960,000; copper, lead, tin, and zinc smelting, 1,280,000; waterworks, 2,240,000; breweries and distilleries, 2,880,000; chemical manufactories, 3,040,000; railways, 3,200,000; steam navigation, 4,800,000; clay, glass, and lime kilns, 4,960,000; textiles, 6,720,000; gas works, 9,600,000; mining operations, 10,720,000; steam engines, 19,360,000; iron and steel works, 48,000,000; domestic use, 27,502,000; and exported, 14,720,000. The whole of this latter item, of course, was shipped, and, in addition, almost as much was conveyed by sea and consigned to different ports in the United Kingdom.

LETTERS TO THE EDITOR.

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

FREE TRADE AND NO TRADE.

Sir,—Some time ago you did me the honour of publishing two letters of mine in which I put forth special propositions, and asked certain questions. For my first letter I was severely taken to task by some of your readers; to my second letter no reply has been given; as I suspect, because the rapid and remarkable change which is taking place in public opinion renders it unwise to assert free trade principles too blatantly. Your article last week on "Foreign Competition" refers to this change, and I venture once more to take the opportunity of airing my opinions, and trying to gain a little information on points concerning which I am shamefully ignorant. The only excuse that I have is, that being a mere trader I have not had time to read much about political economy; not that I am ignorant of the writings of Adam Smith, Mill, and Mongredien, to say nothing of lesser lights. But I have found that so little of what they had to say applied to my own case that their books seemed to me to be more academical disquisitions than practical manuals of trade. This is, I suppose, a result of dense stupidity on my part; but this is my misfortune, not my fault, and I hope that some of your correspondents will not only bear with me, but even enlighten my ignorance a little.

I have put forward already the proposition that, on the whole, that country will be best off, happiest, and most contented, in which the largest number of the inhabitants find employment which will enable them to live with moderate decency of life. The amount earned is not so much a matter of consequence as the number earning it. Let us say, for example, that in a given district containing 500 working men, the distribution of employment and wages is such that 300 earn £2 per week each regularly, while 200 walk about beg, bully, or hold Socialist meetings, being driven thereto, poor souls, by dire want, or earn a few shillings by doing odd jobs. It is clear that the wages going into the district, and paid by consumers, is £600 per week. Now I maintain that the district would be, on the whole, better off if the whole 500 men were regularly employed at 24s. a week each. The sum expended in wages in the district would be the same in both cases; but in the latter case there would be no begging, no starvation, and no abject misery such as would abound in the former case. May I ask your readers who hold different views to tell me of their courtesy where my proposition is unsound; and to point out the advantages which ensue—if any—from so distributing wages that some men will be well off while others are driven to compulsory idleness. In what way and why is such a system better than that which I advocate, viz., the greatest possible distribution of employment?

In my former letter I have maintained that in a rich country like this the imposition of a judicious import duty would be followed by the employment of numbers of people who are now idle. Thus, for example, I would admit raw silk into this country duty free, because we cannot, for climatic reasons, grow silk ourselves; but I would put such an import tax on all manufactured goods as would induce capitalists to invest in silk factories in this country, and so give employment to large numbers of men and women who are now idle. I must not occupy your space now by extending the enunciation of my no doubt ignorant opinions on this subject, but I shall once more be much obliged to any of your readers who will tell me why I am all wrong, as no doubt I am, about the silk business. As I have rather a weak brain, may I point out that it will be desirable to confine the exposition of my errors to silk alone. If my teachers begin to mix silk with wheat, and flour, and wool, and so on, I shall only be mystified, whereas if I have it clearly set forth that it is better for England that she should not employ any of her population in spinning, weaving, dying, and printing silk—although it is highly desirable that they should be employed in spinning, weaving, dying, and printing cotton—I shall have something on which to rest the sole of the politico-economical foot; and, after taking breath, I can go on to consider the disadvantage which must accrue to the country from employing men and women, Queen Victoria's subjects, in other trades; and so, at last, I may perhaps see that England would, on the whole, be best off if she carried on no trades at all, but bought everything she wanted from the foreigner.

There is yet another branch of the subject which I entirely fail to understand. I may be mistaken in my figures to a moderate extent, but I fancy I am not far wrong when I say that over 15,000,000 of the inhabitants of Great Britain and Ireland live directly or indirectly by agriculture. In this I would, of course, include the shopkeepers and the families of the shopkeepers, who live in small country towns and villages, and depend on the farmers and the farmers' wives and daughters and workmen, for business. The number is so great that even if I am wrong by a million or two it will not greatly affect the matter.

I think I am also right when I say that the men, women, and children of Great Britain who derive their living from manufactures and mining, do not exceed about 4,000,000. Now, it is clear that, were a moderate duty put on the importation of corn, 15,000,000 of people would be greatly benefited, while at the most 4,000,000 people would be injured to an extremely small extent. Why, under these circumstances, is it right that wheat and flour should be let into this country free? Why is it right, in other words, that a man should burn down the largest portion of his house in order to save the cost of putting a few slates on the roof of the smaller portion? I have no doubt that there is a good answer to this, and that it is quite right and proper that land should be depreciated in value; but, in my benighted ignorance, I cannot see it. I pray for enlightenment.

Also, I would like to know how long it is supposed to be likely that the agricultural population—who are now, thanks to the extension of the franchise, able to outvote the manufacturing interest two to one—will permit the existing state of affairs to last, and what will happen when the agriculturist has been taken possession of by the right kind of political agent? It seems to me that the time is close at hand when a protectionist party will arise in this country; will win over the whole enormous agricultural population, and go into power on the back of such a wave of popular opinion as has been rarely witnessed—a wave which will sweep all free trade opposition before it.

Lastly, I would ask one more question. This country now raises by taxes of various kinds pretty nearly £100,000,000 annually. Why, I want to know, should not a large part of this sum be got from taxing the import of manufactured commodities of all kinds. Many years ago there was a tax of 1s. a quarter on wheat imported. This duty brought in a revenue of about £1,000,000 per annum. Mr. Gladstone took this duty off. I never heard that bread became any cheaper in consequence. It did the British farmer much harm, because it is well known that the growing of wheat at a profit abroad is a very ticklish operation, leaving only a small margin. Mr. Gladstone, to make good the deficiency in the revenue, a little afterwards put on a penny to the income tax, and a penny at that time just brought in a million sterling. Now, will some of your readers kindly tell me why it was right to injure the British farmer and put a penny on the income tax, instead of letting the corn imported pay its duty? Again, why should tea, which is the poor man's necessity, be taxed at the rate of about 33 per cent. of its value, while corn is let in free?

I do hope your readers will not consider me troublesome. I have talked to a great many people, but I can get no satisfactory replies, one says one thing, another says another thing. Not long since, travelling by rail, I chanced to see the managing director of a great trading company in the North enter a first-class carriage. I changed my own ticket—modest third-class—and so managed matters that I soon found myself in the compartment with him. A little tact and courtesy on my part led to conversation. Our journey lasted some hours. I knew my fellow-traveller to be an ardent free-trader, and a most successful man. He was not long in finding out how ignorant I was, and how anxious for information which he freely imparted. I shall never forget almost the last words he said when we parted: "Free trade was at one time a necessity for England, and she would now be the greatest nation on the face of the earth had other nations adopted free trade principles. As matters now stand, as events have turned out, free trade on her part and protection on the part of other nations will be Britain's ruin. We manufacturers cannot now change our policy, and the longer the agricultural population remain in ignorance of their power the better; but I give Britain at the most seventy years before her downfall, and that downfall will be due to the transfer of her capital to protected nations, and to the circumstance that the country will be entirely unable to find employment for its population." I know the speaker well, because he is a public man. I asked him did he think it a good thing that a country like England should depend for its food wholly on other nations. "What, for example, would happen," said I, "if we had a great war on our hands?" "It is not a good thing," he replied, "but it is unavoidable, and England for that reason can never again carry on a great war. She will do as the Romans did during the decline and fall; buy her enemies out. It will be cheaper to pay than to fight, and besides we should be starved if we fought." To this day he does not know who his fellow-traveller was. Possibly he may see what I have written; possibly not. I have endeavoured to reproduce his words as nearly as possible. I send you his name in confidence; you will see how eminent a free trade authority he is.

I pray you and your readers to pardon the length to which this letter has extended. May I hope to find an excuse in the circumstance that I am only an ignorant

London, October 11th. Trader.

FOREIGN COMPETITION.

Sir,—I have read with lively interest the leading articles you have published respecting this matter, and the very sensible letters of "U." in these columns. This gentleman is perfectly right; it is a Commercial Education Bill we need in England, the commercial education of the Germans is decidedly superior to that of either the French or the English. We have, as a nation, a great advantage over other nations, namely, we recognise our own defects and try to remedy them; but this to be efficient and really meritorious should be due to our private initiative, for I do not believe much in State interference—the State makes us pay dearly for his paternal care. There are in our country sufficiently well-developed elements and powers to carry out the needed reform, which is a work of time; we need not await the reform from the State, the manufacturers and the public must be impressed with the imperious necessity of improving the education of our commercial men and that of the engineers who have extended business relations abroad. Although I have scarcely entered the engineering career, I must say that "U.'s" remarks are true. I have had many occasions to make similar ones when I was on the Continent. After all, there is a deal of confused ideas respecting the so-called technical education of workmen. I have met but very few foremen who had attended a technical school; all of them, and even those who had done so, had had a long experience as workmen. No doubt the technical education of our engineers could, and ought to be improved, more especially that of those who intend to go abroad. It is not to be hoped too much that a young English engineer having served his apprenticeship in England would find a situation on the Continent in a native firm as engineer, as the first condition to be engaged as such is to have a diploma of technical studies. The English engineer who has to deal directly with foreigners should therefore be better educated than the one who stops in England. But this is matter in which an Act of Parliament would be of little use. Practical men know best what is really to be usefully learnt for each special branch of engineering.

Turning to your leader of last week, I would say, respecting the latter part of it, that it is unfortunately too true that bribing is too often the means resorted to by foreign firms to obtain orders. In the Eastern countries of Europe the people seem to consider this as a condition of their giving orders to a firm; they generally expect it. I know many instances of English firms failing altogether to do business because of their unwillingness to submit to this very dishonest practice. It is no wonder therefore to see Germans successful there. On many a foreign railway in these countries many an untalented or obscure official has enriched himself in this manner. A firm who is possessed with a really good invention or really good article defeats its own end by adopting such means, which conscience alone repudiates.

Lastly, I would caution English manufacturers against appointing as their agents German Jews without having thoroughly inquired into their character. There are even such people in England, acting as exporting agents, who carry on busin ss in a very dishonest manner. I know a great English company who has mostly failed to succeed on the Continent through employing Jewish agents. These men are the biggest braggarts that can exist; they possess too much of the qualities you find wanting in the English. Many a good firm has sadly failed owing to the dishonest proceedings of these men. In the first place, Germans themselves and many other continental nations have an inborn dislike for Jews, and, on the other hand, these are not very scrupulous in their way of doing business, and look after their own interest before that of the firms they represent. I knew in England a Jew who exported English machinery he had bought in England. He sold it at exorbitant prices. That was not all; he succeeded in many cases in inducing the people to believe that he was the actual manufacturer of the goods. This sort of doing has been in many cases the cause of American or German firms beating the English on the foreign markets where he did business.

It is not a feeling of anti-Semiticism which has dictated the above lines, but a wish to remedy an evil which is not always well known in England. There are, of course, Christians who deal just as bad in business as these Jews. I must also add that I have a good many friends who are Jews and are belonging to very honourable families, and occupy high positions in the engineering business. Nevertheless, it will be good not to entrust the representation of an English firm to a German Jew without knowing thoroughly all concerning his honour and business capacities.

Manchester, October 9th. E. Gobert.

THE COMPLETE PROTECTION OF IRON AND STEEL SHIPS' BOTTOMS AGAINST RUST.

Sir,—In the interest of our many shipowning clients, we think it our duty to call the attention of the shipowning and shipbuilding public generally to the fact that experiments have been recently made with a view of preventing the falling off of paint and compositions from new iron and particularly steel ships' plates. These experiments have been highly successful, and are also, in our opinion, calculated to overcome this long standing evil, which has most particularly manifested itself of late in consequence of the substitution of steel for iron plates in shipbuilding.

All new vessels invariably throw off most of their first paint. This is due partly to the smooth surface of the plates, partly to the existence of bloom on their surface, which, after a short time, detaches itself and falls off with the paint, thus exposing large portions of the plates to the deleterious effect of the salt water. Moreover, there is continuous chafing between wind and water by lighters and quay walls, and in the bows by the anchor chains, whereby large surfaces of paint are removed and much rusting results.

The Admiralty and a few private shipowning firms have attempted to find a remedy by bathing the plates in a weak solution of hydrochloric acid before rivetting them on the frames, thus removing the bloom from the iron or steel and producing a slightly porous surface on which the paint can get a readier hold. This is a rather expensive process. It requires very careful handling, for an appreciable amount of iron or steel may be lost if the plates are allowed

to remain too long in the acid. Besides, the surface produced is not sufficiently rough to secure the adhesion of the paint in event of chafes from the outside.

To overcome this difficulty it has been tried to rough roll all the plates to be used in the construction of a vessel, that is to substitute rollers with a rough surface similar to a fine file, at the iron and steel mills, for the present style of rollers, which are perfectly smooth.

So far these experiments have been perfectly successful, and we for our part, judging this new method from our long experience and careful study of the subject, have come to the conclusion that this method is likely to find a speedy adoption if careful trials are made.

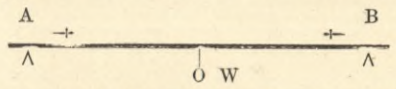
By having the surface of the iron rough, we do not think much scale, if any, would be formed, and the paint which may be applied would at once find a suitable surface for permanent adhesion. When chafed, only small particles of the paint would be removed, the rest of the paint remaining protected by the unequal surface of the iron, and the rusting consequent upon chafing would be only of the most insignificant nature. The roughness of the surface finally would not affect the ship's speed, as, when covered with a few coats of paint, a surface equal to that on smooth rolled plates would be produced.

We have, therefore, every confidence in recommending to all those who are connected with ship-owning, shipbuilding, &c., to interest themselves in any further experiments which may be made, with a view of ordering or building steamers, with rough rolled plates, and thus adopting a safeguard against the rapid deterioration which has recently been experienced. Any ship-owner, shipbuilder, or ironmaster desiring further information on this subject will always find us at his service.

Quayside, Newcastle-upon-Tyne, October 11th. HOLZAPFEL AND CO.

STRESSES IN TENSION RODS.

SIR,—The question of initial strain in bolts has occupied your columns for some time. Perhaps some of your correspondents who have devoted their time to solving the question raised by "X." will give a solution of the following question, in which initial strain also comes in:—



A B is a bar supported at two points, and having an initial tensile strain in the direction of the length of the bar, of, say, 5 tons per square inch. If a weight W be now hung in the centre of the bar, what strains are produced in the bar?

One of the practical applications of this problem is the case of cross girders being placed on the lower booms of lattice main girders in the centre of a bay. L.

October 13th.

TRIAL OF STONE BREAKERS.

SIR,—Kindly allow us to correct a few errors upon the above in your last week's paper by Messrs. Mason and Co. They say that the report does not give the maker's name of the Blake machine. We have no desire to advertise down An Honourable Competitor, hence our reason in not giving it in our advertisement. We may say that the maker is one of the oldest, being formerly maker to the late Mr. H. R. Marsden, who had sole patent right of these machines in England. They have also replaced one of Mason's machines in Manchester, and supplied one to a firm at Nuneaton, who had returned a machine of Messrs. Mason and Co.'s, and several other instances we might name to prove that they are superior makers to Messrs. Mason and Co. With respect to the breaking of the belt on the Blake machine, this did not occur during the trial but prior to; the machine during the trial being driven by a 5in. new leather belt, and ours being driven by a 5in. Lancashire belt. With respect to power, both machines had ample power behind them, our machine being driven by an 8-horse power portable by Messrs. J. and H. McLaren, which during the show worked two of our machines, the other being driven by a 7-horse power portable by Messrs. Robey and Co. With the exception of the amount of power, we may say that all conditions for working were the same, excepting perhaps the movement of the jaw, and it would be a point unfair to any maker to say that he should work with the same movement of jaw as a totally different constructed machine both as regards motion and jaws, as different kinds of stone and forms of jaws require a different amount of movement to enable the machine to give out the best results, not only as to economy of power but quantity broken and sample produced.

With respect to their closing remarks, that "they are makers of the only machine that does not alter its movement:" there is not a stone breaker designed but what is liable to alteration of movement, either through wear of moving parts, or other more dangerous forms of construction.

Respecting the other trial referred to by Messrs. S. Mason and Co., in which they fail to give the size of machines and the particulars, we give these in order that your readers may have an opportunity of judging for themselves of the merits of this trial. The trial was witnessed by two representatives of the Kettering Iron and Coal Company, who required a machine. They sent a truck of slag (about 6 tons) to each. Our machine was a 12 by 7 Patent Knapping Motion, the second made on this principle, supplied to Messrs. Rawson and Rawson, of Enderby, who for some time worked it breaking 50 tons of granite per day with a 2½-horse power vertical engine and boiler, which had for some time previously driven a chaff-cutter. This machine broke the truck-load of slag to not larger than 2in. ring in 46 minutes, the machine only being set on two 3in. planks.

Mason and Co.'s machine, size 20 by 9, and a pair of rolls 20in. wide, broke the other truckload in thirty-five minutes, fixed on properly constructed foundations, and driven by a very powerful engine. In ours the jaws were nearly worn out, whereas Mason's had had new jaws put in specially for the trial, and other repairs; and as we can get double the work out of a 16 by 9 than a 12 by 7, certainly a 20 by 9 should give off more without a second machine 20in. wide passing half or more of the material through that had not been broken small enough by the stonebreaker. We therefore claim that these two machines should have done the work in fifteen minutes to have been equal in quantity to our 12 by 7, without taking the power into account.

Now, respecting their opening remarks that "there is no machine made that will do more work than the Blake." We will give a few trials of our machine, and let Messrs. Mason and Co. produce anything, either from their machine or any other, to equal it.

At Calcutta Exhibition, after an official trial, ours breaking 7 tons to 2½in. in forty-five minutes, we were awarded a gold medal, our competitor being the original English maker of the Blake machine. Our 16in. by 9in. at the Inventions Exhibition, running only at 210 revolutions per minute, broke 5 cwt. of granite in 1 min. 40 sec. Gold medal awarded after first refusing silver medal. A trial of three different kinds of stone with our 16in. by 9in. machine, by the Lanark Road Trustees, gave off the enormous quantity of 18 tons 13 cwt. in sixty-one minutes to 2½in. ring. At the Royal Show at Shrewsbury ours was selected in preference to the Blake machine, either lever or excentric, although our price was £53 more than the catalogue prices of the others exhibited.

We have supplied all Corporations who have purchased stone breakers except one for over three and a-half years, including Leicester, who previously used a Blake.

With regard to durability. Whereas numerous ends of machines, on the Blake and other principle, have been burst out, to which Mason's are by no means an exception, we challenge them to produce an instance of the end of one of our Knapping Motion Stone Breakers being burst out.

In conclusion, we would suggest through the medium of your paper that the Royal Agricultural Society, at its next meeting at Nottingham, thoroughly test the efficiency of stone breakers, in order that purchasers of these machines may have further proofs of their capabilities. A set of rules for such a trial we enclose.

What we should consider the basis of a trial would be as follows:—First, 29 tons of stone of the same kind to be broken by each machine; secondly, all competing machines should run at the same speed, or as near as possible, and be driven by the same engine—engine indicated shortly after starting and prior to finishing—machines being properly fed during such indicating; thirdly, machines to be of same dimensions, say 16in. by 9in., this being a medium size; fourthly, each competitor to have full power to regulate his machine as desired in order to give the best results, but that the whole of the stone broken must pass through a ring not larger than 2½ diameter; fifthly, quantity of coal and water consumed; sixthly, time occupied; seventhly, labour required to put stone into and take it from the machine.

We trust you will excuse us for trespassing so much on your valuable space, but we felt bound to give full contradiction to misleading statements.

Leeds, October 9th. W. H. BAXTER AND CO.

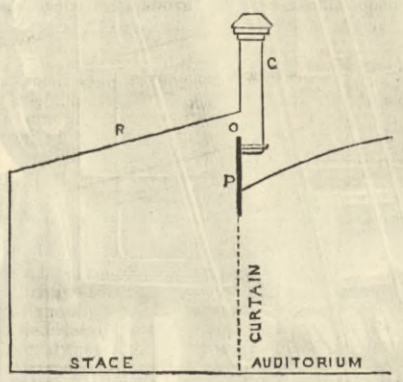
SIR,—*Re* test of stone breakers. Kindly permit us to correct a misinterpretation of our letter of 26th ult. The breakage of the leather belt driving the "Blake" machines did not occur during the official five minutes' test, but in the preliminary runs. The new belt drove throughout the competition time.

Pp. Lancashire Patent Belting and Hose Company.
S. J. M'MECHAN.

Strangeways, Manchester, October 10th.

FIRES IN THEATRES.

With regard to the suggested plan of "Bob" for effecting the escape of the suffocating smoke and the products of combustion in the event of fire in theatres, I would consider the following idea of my own as being an improvement on his design both in principle and in practicability. It would be really too much for any discerning person to expect that the smoke would make its exit through the proper channel in so condescending a manner as your correspondent imagines. The annexed diagram, in longitudinal section, speaks sufficiently for itself. The ceiling—fireproof—of the stage is made slanting upwards towards the proscenium wall P both laterally and longitudinally, so that instead of being one plane surface, the ceiling consists of two surfaces inclined just as in a roof of which R forms the ridge line. At the highest part of the stage ceiling there is an opening O for the escape of the smoke through the chimney C; and it is evident that the higher the stage space rises above the proscenium opening, the more



effective this arrangement will be. I would consider also that the fireproof stone staircase, now so much adopted, is far from being the ideal of perfect construction. I have already pointed out, in a weekly journal, that it is essentially necessary to have the bearing surface of the stairs capable of affording a very firm foothold. Persons are apt to slip and fall on stone steps, thus causing a block and loss of life to ensue. This element of danger is deserving of serious consideration in the case of a rush for life through a steep descent. I am of opinion that the stone steps should be overlaid with lead, and even if overlaid with wood, though the staircase would then be theoretically less safe, it would be practically much more secure. E. H.

76, Upper Dorset-street, Dublin, October 11th.

PRESTON DOCKS.

SIR,—It may interest your readers to know that Mr. Sykes estimates that the gross receipts of Preston Docks will be about £90,000 per annum. From this is to be deducted £45,000 a year interest on the money borrowed to construct the docks and the estuary works, and £20,000 per annum the estimated cost of dredging, leaving for profit about £25,000 per annum. This does not appear to be a large margin.

Should the cost of the works much exceed the present estimate, there would obviously be no margin at all. Thus, if another £500,000 should be wanted, bringing the whole cost up to £1,500,000, there would be no profit whatever. The estimate for income is based on the assumption that about one million tons of shipping will use the docks per year. This means about 2700 tons per day every day of the year, and seems to me to be a very large estimate for a place of about 110,000 inhabitants like Preston.

Mr. Sykes' comparison between Preston and Liverpool is amusing. Two wrongs do not make a right, and because ships of the largest class have to wait for water on the bar of the Mersey, that does not prove that waiting for the tide is a thing of no consequence, a trifle not to be considered. NEMO.

Liverpool, October 10th.

THE HEXTHORPE COLLISION.

SIR,—In your issue of last week on this subject, I notice letters from Mr. Clement E. Stretton and Mr. A. W. Kapteyn, manager of the Westinghouse Brake Company. With regard to the former, I cannot see how Mr. Stretton, who, it is admitted, is consulting engineer to the Railway Servants' Association, can be considered an independent engineer; and regarding the latter, one is almost tempted to look at it in the light of an advertisement from the Westinghouse Brake Company.

It is absurd to contend that the fact of a train not being fitted with an automatic brake has anything to do with the question of negligence; any defence on this head seems to me to be utterly absurd. The driver knew that he had a simple brake, and of course knew what it would do and what it could not do. The fact that he might possibly with an automatic brake have negligently run past the flags and yet had no accident, relying upon his brake to save him from the consequences of his negligence, cannot possibly be a defence to the charge now made. If it were otherwise, the driver of a train only fitted with the hand brakes might say that he was justified in running into a station with a dead end at forty-five to fifty miles an hour, because if he had had an automatic brake he could do it without accident.

15, Walbrook, London, October 10th. JOHN E. HOPKINSON.

SIR,—In my letter upon this subject in your last issue I referred to the fact that the engineers called on behalf of the driver and fireman were not allowed to examine the site of the disaster or the train. I have since been informed by the solicitors that the railway company is now willing, or will not further object to the examination being made. I am now informed that the original report that there was a tri-coupling in use was incorrect. The tender and all the vehicles had the single-brake pipe.

CLEMENT E. STRETTON (of Leicester).

306, City-road, London, E.C., October 10th.

SIR,—I may add to my former letter that to-day a minute examination of the line at Hexthorpe has been made by the engineers for the men. A van was placed at the point of collision, and the driver of the Manchester, Sheffield, and Lincolnshire train pointed out the spot where he applied his vacuum brake. We then measured the distance from where the brake was put on to point of collision, and found it to be 16 chains and 22ft.

Doncaster, October 11th. CLEMENT E. STRETTON.

NAVAL DOCKS IN CHINA.

A CORRESPONDENT, reverting to the remarks in our paper of the 2nd instant on the difficulties arising from the urgent needs of docking accommodation and facilities for repairing the ships of the Imperial Chinese Navy, informs us that, if the present rate of progress in the works is continued, the dry dock and wet basin of Port Arthur will not be available for some years to come. The Imperial Government must, therefore, until the Port Arthur docks are ready, cleanse the iron bottoms of the fleet and effect repairs in other places. As the Japanese arsenals are now to be considered as out of bounds, the Chinese ships must be docked in Shanghai, or Foochow, Amoy, Hong Kong, or Whampoa. Our correspondent gives us some valuable details of the docks in these places, which we reproduce.

At Shanghai there are four large dry docks, all well fitted with machinery for effecting small or great repairs to hulls, engines, or boilers. But as all these docks are of timber, and have been excavated from an alluvial and, in general, unstable soil, they are not, in our opinion, suitable for vessels which carry armour, and in consequence have their weights concentrated amidships, and not distributed.

The largest dock is that of Messrs. Nicholson and Boyd at Putung, a work well built, and well fitted with adequate mechanical appliances. This dock has 450ft. length on blocks, 80ft. width at entrance, with depth of water on sill at spring tides, 21ft., and at neap tides, 17ft.

The next largest Shanghai graving dock is called the "Old Dock," and is at Honkew. The length on blocks is 380ft.; width at entrance, 57ft.; depth of water on sill at spring, 17ft.; and at neaps, 13ft.

There is also a dock on the Putung side, opposite the Chinese city of Shanghai, called the Tung Ka-du Dock. The length on blocks is 325ft., width at entrance 70ft., depth of water on sill at springs 16ft. Nearly opposite to it is the dry dock of the Chinese Arsenal, which has 320ft. length, and at spring tides a depth on sill of 18½ft. The lower dock, nearly half-way to Woosung, is only suitable for gun-boats, as, though it is 345ft. long and 70ft. wide, the depth of water at entrance is only 11ft. at high tide. If an ironclad should be placed in any of the Shanghai docks the risk would be considerable. The two larger citadel turret ships of the Chinese Navy each weigh 7400 tons, mostly amidships, as the two ends are comparatively light, being unarmoured. If the dock floor sank ever so little the vessels would deform, and the injury that would be done to them in such case would be irreparable. For the cruisers and unarmoured vessels the four principal docks of Shanghai would give ample accommodation. But for the reparations of the Northern fleet Shanghai is too remote in time of war.

At Foochow Arsenal there is a wooden patent slip, erected in 1870, but the timbers are now wormed and decayed, so that it would not be safe to place on the cradle any but small and light vessels. Adjoining the arsenal there is a fine granite dock built by Mr. John Forster, which could easily be lengthened so as to receive vessels of about 320ft. in length, or even a little longer.

Amoy docks are small but well placed, and have solid bottoms. The large dock could at no great charge be made fit to receive the Armstrong cruisers and the partially armoured vessels built at Stettin in 1883. At Hong Kong there are two large granite docks, the "Cosmopolitan" at Kowloon, and the "Aberdeen" at back of the island. Either of these docks can receive such vessels as the English flagship Audacious, or the French flagship Turenne. But at the end of the year the new dock at Kowloon, one of the finest in the world, will be open, and able to receive the largest, broadest, deepest, and heaviest ironclad afloat. Such craft as H.M.S. Sans-pariel, weighing nearly 13,000 tons, or the Italian ship Lepanto, weighing 2000 or 3000 tons heavier, can be taken in easily without unloading or reducing weights.

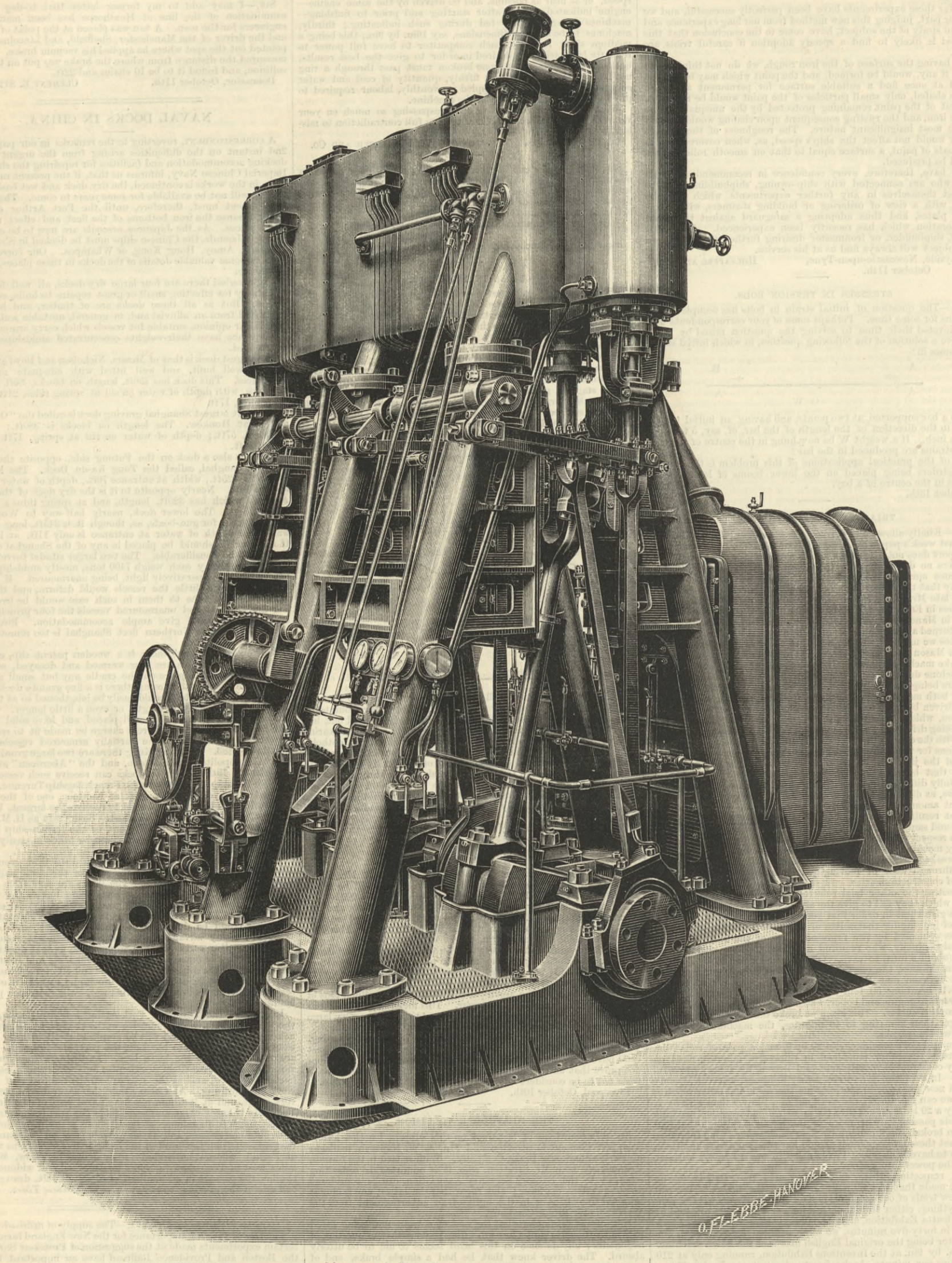
At Whampoa there are two docks on good firm ground with ample depth of fresh water at the edge of the dock walls, which might be again made useful. The docks are now in a decayed state, having been neglected for some years, but as the sites are good and the excavations exist, good docks might be easily reconstructed. The site of Whampoa is excellent. The entrance to the river could be defended at the Bocca Tigris, and of course there are many advantages in having a fresh-water dock and anchorage. Our correspondent agrees with us that docking iron-bottomed vessels once yearly is not sufficient, and confirms our statement that the ships of the fleet, one and all, are so much pitted and eroded that in a brief while the injury, which is of a most serious kind and essentially structural, will become painfully manifest.

In any case the position of Port Arthur is scarcely adequate for the Pei-yang fleet. The defensive works erected by Mr. von Hanneken are admirable, and will be ample to resist attack. But it would not be difficult to blockade the port, and few or no supplies are obtainable from the main land. At Wei-hai the Chinese Government has an excellent position for an arsenal and docks. The harbour is good, and at the rear are all the resources of the province of Shantung. At Chiao Chow the natural advantages are very great, and fit it admirably for a naval port of the first class. The basin is large, deep, and accessible; the port is sheltered from winds; there is abundance of fresh water, cattle, provisions, &c., to be obtained around, and at no great outlay an old junk canal that was cut from the head of the harbour to an outlet in the Gulf of Pechili, where it entered at a place named Lia-chow, 80 or 100 miles west of Têng-chow-fu, could be deepened and widened so as to allow the passage in all weathers of vessels of 18ft. draught from one side of the province to the other.—*The Chinese Times.*

RAILROAD SLEEPERS IN AMERICA.—The supply of railroad sleepers is a matter of growing importance for the New England farmer, and certain experiments made at the suggestion of Professor Sargent by the Boston and Providence Railroad have an important bearing. Fifty-two ties were laid on a track in Boston, where the traffic is very heavy, having an average of sixty-five trains daily. Ten kinds of wood were tried, five in the natural state and five creosoted. None of the ties rotted except one of the ailanthus. The others that had to be removed had been injured by the hammering of the trains. Spruce, hemlock, larch, and southern pine have all suffered badly in this way. White oak lasted well, but it holds the spikes so firmly that they cannot be drawn when the rails have to be shifted. Creosoted elm and birch did well, and are to be recommended. Chestnut was, unfortunately, not included in the experiment, although it is considered one of the best woods for ties. The behaviour of the catalpa was one of the most interesting features of the case; it has been highly spoken of for ties on account of its practical indestructibility when placed in the soil, and all the ties of this wood there tried are still sound, except under the rails, where they are crushed nearly to pulp, so as to be of no service whatever for roads of heavy traffic.

TRIPLE EXPANSION ENGINES, S.S. BENCROY.

MESSRS. J. JONES AND SONS, LIVERPOOL, ENGINEERS.



ENGINES OF THE BENCROY.

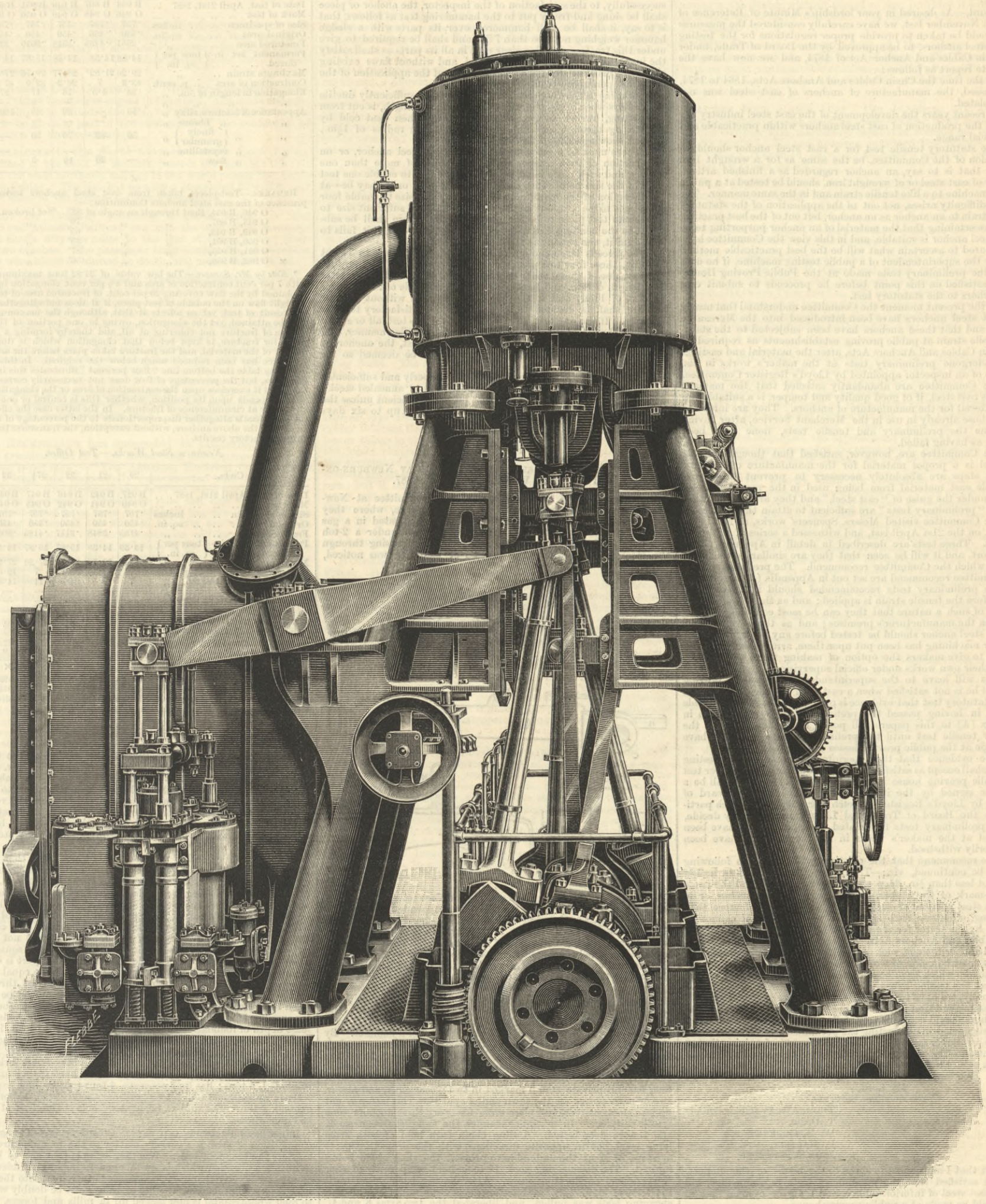
Above and on page 309 we illustrate the triple expansion engines of the steamship Bencroy, constructed by Messrs. J. Jones and Sons, St. George's Works, Liverpool. It will be seen that the engines differ in some respects from the normal type. The steamship Bencroy has been built for Mr. Joseph Hoult, steamshipowner, by Messrs. John Jones and Sons, shipbuilders and engineers, at their shipbuilding yard, Brunswick Dock, Liverpool. She is of the following dimensions, and has the highest class at Lloyds':—291ft. by 38ft. 3in. by 28ft. 6in.; gross tonnage, 2518. She has cellular bottom, and the tanks when filled contain about 800 tons. She is built of Siemens Martin-steel throughout, and the whole of the material has been subjected to Lloyds' tests. She is rigged as fore and aft schooner, and has great facilities for the rapid discharge of cargo. She is specially ventilated for coal cargoes. She is propelled by triple-expansion engines made by the builders, at their engine works in Regent-street, and on the trial trip developed 1000-horse power, working with 160 lb. pressure and making 76 revolutions, made an average speed of 10½ knots. The cylinders are 21in. and 35in. and 53in., by 3ft. 6in. stroke. The engines were remarkably free from vibration, as there was not $\frac{1}{16}$in. of motion in the cylinders, either fore and aft or athwartship. The trial trip was a perfect success. In the six hours' run no variation of speed was made, except on signal from deck; no water was used on the bearings, there were no heated bearings and no priming. The Bencroy, after the trial trip, returned to the river to land the guests of the owner and engineers, and proceeded immediately to Newport to load her first cargo of coal for the Canary Islands.

The Society of Engineers.—Arrangements have been made for the members and associates of the Society and their friends to visit, on Wednesday, the 19th inst., the new sewerage works at Acton, the refuse destructors at South Ealing, and the new reservoir—in progress—of the Grand Junction Waterworks at Ealing. The Acton Works lie midway between the Acton Station of the North London Railway and Turnham Green Station on the Metropolitan. The party will meet at the works at 11.30 a.m., where they will be received by Mr. William Roebuck, C.E., the chairman of the Acton Local Board, and Mr. C. N. Lailey, their engineer, and will proceed to view the new purifying process in use there. The members and friends will leave at 1.40 p.m. for the works at South Ealing, where Mr. C. Jones, the engineer to the Ealing Local Board, will explain the refuse destructors in operation. From thence the party will go in the same carriages to the new reservoir, where they will be received by Mr. Alex. Fraser, the engineer to the Grand Junction Water Company, and Mr. B. P. Ellis, of Messrs. Aird and Sons, contractors for the work.

TRIPLE EXPANSION ENGINES, S.S. BENCROY.

MESSRS. J. JONES AND SONS, LIVERPOOL, ENGINEERS.

(*For description see page* 308.)



THE FASTEST CRUISER IN THE WORLD.

The Spanish cruiser Reina Regente, built by Messrs. Thomson, of Clyde Bank, has already been described in our columns. She has just made her official trips, which place her as the fastest cruiser in the world. The trials were made under the inspection of the Spanish Commission president, Commodore Casarigo, on Monday. The vessel was under forced draught for four runs on the measured mile and two hours continuous steam. The average speed attained was 20·6 knots. On Wednesday a trial was made for six hours' continuous steaming with natural draught. The mean speed attained was 18·7 knots. This vessel was ordered by the Spanish Government of Messrs. Thomson in June last year, as the best of fifteen competitive designs submitted by various builders. She has a normal displacement of 4800 tons. Her load displacement is 4600 tons. She has a protective deck 4·75in. thick, carries four 21-ton, six 12-c.m., and twelve small guns, and is fitted with five torpedo tubes. Her engines indicate 12,000-horse power. The vessel is fitted with Thomson and Biles' rudder, which turns her in a very small circle. Mr. White, Director of Naval Construction, was present at the trial. The vessel has been built in a very short time, and is a splendid illustration of the capabilities of private shipbuilders to design and construct war ships.

The Heisler Incandescent Light.—The Heisler Electric Light Company of St. Louis, of which Messrs. Hyer and Montgomery, Aldrich Building, New York City, are the agents for New York State, has recently put up a line of its incandescent lights for the lighting of the streets of the villages of Fishkill Landing and Matteawan, N.Y., and the people of those places—which are virtually one village—had a celebration in honour of the inauguration of the system. This company has put up these lights in quite a number of cities in various parts of the West, but has never until now put its system into practical operation in the East. The special feature of the Heisler system is that the lamps, which are from 20 to 200-candle power, and which are very steady and white, are all included in a single circuit, thus obviating the objections to systems which have to be worked on the "multiple-series" plan. The streets of the towns mentioned have eighteen miles of wire, from which 183 20- and 30-candle power lights are furnished. The wire is of copper, No. 8 or 9 B, and S gauge; and the power lost by distance from the dynamo is reduced to a very small percentage, the loss being only one 30-candle power light per mile. Some of the machines in the West supply circuits of over twenty miles each, and those who have used the lights testify in strong terms to their steadiness and brilliancy, and also to the small amount of power used. The lights at Fishkill on the night of the opening were white and steady, much whiter than the ordinary incandescent lights, many of which often appear quite yellow; and yet there was none of the dazzling whiteness which is seen in arc lamps. The placing of an indefinite number of lamps in a single wire circuit, which is as simple as an ordinary telegraph circuit, and the absence of the numerous shunt-boxes and other regulating devices, which are so common in electric light systems, would seem to be a strong point in favour of this system, and make it specially adapted for the lighting of stations, engine-houses, shops, or places where skilled attendants are not readily available. The machine at Matteawan is run by water power. The company guarantees either seven 30-candle power or ten 20-candle power lights to the horse-power.—*Railroad Gazette.*

CAST STEEL ANCHORS.

The following report has been sent in to the Right Hon. Lord Stanley of Preston, G.C.B., &c., President of the Board of Trade, by the Committee appointed by the President of the Board of Trade to settle questions connected with the testing of cast steel anchors:—

My Lord,—As desired in your lordship's Minute of Reference of the 26th November last, we have carefully considered the measures that should be taken to provide proper regulations for the testing of cast steel anchors, to be approved by the Board of Trade, under the Chain Cables and Anchor Act of 1874, and we now have the honour to report as follows:—

1. At the time the Chain Cables and Anchors Acts, 1864 to 1874, were passed, the manufacture of anchors of cast steel was not contemplated.

2. In recent years the development of the cast steel industry has brought the production of cast steel anchors within practicable and commercial range.

3. The statutory tensile test for a cast steel anchor should, in the opinion of the Committee, be the same as for a wrought iron anchor; that is to say, an anchor regarded as a finished article, whether of cast steel or of wrought iron, should be tested at a public testing machine to a like tensile strain and in the same manner. The present difficulty arises, not out of the application of the statutory tensile strain to an anchor as an anchor, but out of the best practical way of ascertaining that the material of an anchor purporting to be a cast steel anchor is suitable, and in this view the Committee have endeavoured to ascertain what will be the best practicable method whereby the superintendent of a public testing machine, if he does not see the preliminary tests made at the Public Proving House, may be satisfied on this point before he proceeds to submit cast steel anchors to the statutory test.

4. At the present moment the Committee understand that nearly 1000 cast steel anchors have been introduced into the Mercantile Service, and that these anchors have been subjected to the statutory tensile strain at public proving establishments as required by the Chain Cables and Anchors Acts, after the material and castings have undergone preliminary tests at the maker's works in the presence of an inspector appointed by Lloyd's Register Committee.

5. The Committee are abundantly satisfied that the material known as cast steel, if of good quality and temper, is a suitable and good material for the manufacture of anchors. They are informed that of those already in use in the Merchant Service, after having undergone the preliminary and tensile tests, none have been reported as having failed.

6. The Committee are, however, satisfied that though suitable cast steel is a proper material for the manufacture of anchors, effective steps are absolutely necessary to prevent other and unsuitable cast material from being used in the manufacture of anchors under the guise of "cast steel," and they are satisfied that suitable "preliminary tests" are sufficient to attain this end.

7. The Committee visited Messrs. Spencers' works, at Newburn-on-Tyne, on the 21st April last, and witnessed a series of preliminary tests. These tests are described in detail in Appendix (B) to this Report, and it will be seen that they are similar in the main to those which the Committee recommend. The preliminary tests the Committee recommend are set out in Appendix (A) hereto.

8. The preliminary tests recommended should in all cases be made before the tensile strain is applied; and as these preliminary tests are of such a nature that they can be most conveniently conducted on the manufacturer's premises; and as the several parts of a cast steel anchor should be tested before any large amount of labour or machining has been put upon them, arrangements should be made to give makers the option of making these preliminary tests at their own works under official supervision.

9. This will leave to the superintendent of a public proving house—if he is not satisfied when a cast steel anchor is presented for the statutory test that evidence is produced that it is of suitable material in having passed the preliminary tests referred to in Appendix (A) to this paper—full power to decline to make the statutory tensile test until the preliminary tests set forth have been made at the public proving house or elsewhere.

10. The evidence that the superintendent of a public testing machine shall accept as satisfactory that an anchor submitted for test at a public proving house is really a cast steel anchor, shall be a certificate signed by the inspector—appointed by the Board of Trade or by Lloyd's Register—in such form and with such particulars as the Board of Trade and Lloyd's Register may decide, that the preliminary tests formulated in Appendix (A) have been conducted at the maker's works in his presence, and have been satisfactorily withstood.

11. We recommend that the existing practice in the following respects be continued, viz.:—The words "cast steel" in hollow letters not less than ⅛in. deep and at least ½in. long, and the name or trade-mark of the maker, must be cast in each anchor, or in each cast steel portion of such anchor when made of more than one casting, otherwise such anchor or portion thereof cannot be accepted by the tester for the purpose of being proved under the Chain Cables and Anchors Acts.

12. All anchor fittings, such as shackles and bolts, pins, forelocks, and rings must be made of wrought iron.

13. Anchors which have been blacked or galvanised will not be received at the testing-house.

14. Finally, we have to state that, practically, our recommendation at the present time is that the existing practice as regards cast steel anchors should continue to be followed with the few alterations we have suggested in conducting the preliminary tests, with a view to ensure a suitable material. We are, however, of opinion that at no distant date the statutes referring to the testing of all anchors and chain cables will need amendment.

We have the honour to be,
My Lord,
Your obedient Servants,
(Signed) Thomas Gray (Chairman).
T. Dodd.
W. H. Greenwood.
B. Martell.
John W. Spencer.

I regret that I am unable to agree to the terms of this Report. I am not satisfied that the preliminary tests recommended will exclude cast steel of inferior quality, and I am of opinion that all tests should be made at a public proving house.

(Signed) Thomas W. Traill.

(Signed) Walter J. Howell,
Secretary.
21st July, 1887.

APPENDIX (A).

Preliminary Tests Recommended by the Committee.

1. *Percussive test.*—Anchors, or when anchors are made of more than one piece, each piece shall be subject to this test, as follows:—The anchor or piece shall be raised the given height for the given weight, and shall be dropped on an iron slab. The given height means that the lowest part of the anchor or piece when suspended shall be at least the given height above the iron slab on to which it is to be dropped. Given weight, 15 cwt. and below; given height, 15ft. Given weight, above 15 cwt.; given height, 12ft.

2. An anchor of the Admiralty pattern shall first be raised vertically to the given height, with its shank and arms in a horizontal position, and shall be let fall from that height.

3. It shall then be raised a second time to the given height, and shall be suspended with the crown downwards. Two iron blocks shall be placed underneath it, and it shall be let fall from this position so that one of the blocks receives it on the middle of one arm, and the other block receives it on the middle of the other arm.

4. The slab for the horizontal test shall be of steel or iron well laid on a solid concrete foundation to the satisfaction of the inspector.

5. If the slab on which the anchor falls is broken, the test shall be repeated until a slab is made that does not break.

6. The blocks for the vertical test shall be solid, and shall be of sufficient height to prevent the crown of the anchor from touching the slab, and shall be otherwise to the satisfaction of the inspector.

7. *Hammering test.*—When the percussive test has been passed successfully, to the satisfaction of the inspector, the anchor or piece shall be slung and freely put to the hammering test as follows, that is to say, it shall be well hammered over its parts with a sledge hammer weighing not less than 7 lb., and shall be required to give under this treatment such a clear ring in all its parts as shall satisfy the inspector that the casting is sound, and without flaws existing either originally or developed as the result of the application of the preceding percussive tests.

8. *Bending test.*—Cast steel may be passed as sufficiently ductile for anchors when a piece of each casting, 8in. in length, is cut from the casting, turned to 1in. diameter, and is then bent cold by hammering through an angle of 90 deg, over a radius of 1½in., without showing signs of flaw or fracture.

9. There must be a piece cast on each cast steel anchor, or on each portion of such anchor when it is made of more than one casting, and such piece must be of sufficient size to enable one test piece of the size before stated to be cut out of it, or it may be—at the discretion of the manufacturer—of sufficient size to enable four test pieces to be cut out of it. If it is only of sufficient size to enable one test piece to be cut out of it, that piece shall be subjected to the bending test named in paragraph 8, and, if it fails to withstand it, the casting is to be condemned.

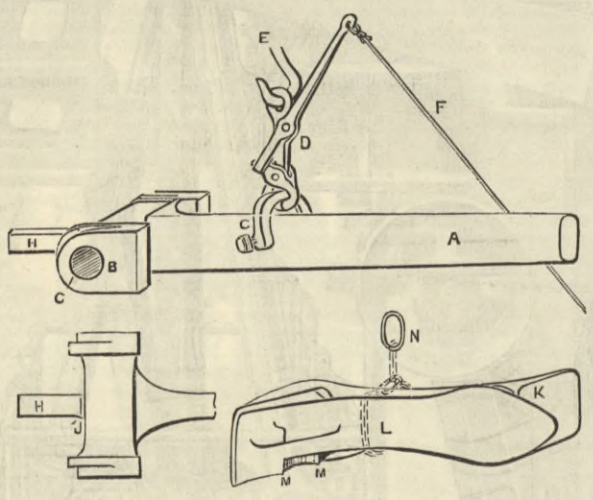
If the piece is large enough to enable four test pieces to be cut out of it, these four test pieces shall be disposed of as follows, that is to say, one of them shall be turned in a lathe to 1in. diameter for a length of 8in., and bent cold through an angle of 90 deg. over a radius of 1½in., and if it withstands this test without flaw or fracture, shall be deemed to have withstood a satisfactory test for ductility. If the one test piece does not pass this test, all or any of the other three test pieces may be tested in a similar manner, and if any one of the four test pieces passes this test, the anchor, or part of the anchor, as the case may be, shall be deemed so far satisfactory.

10. *Annealing.*—Each anchor must be properly and sufficiently annealed, and when so annealed shall be stamped "annealed steel." Annealing is not to be regarded as proper or efficient unless the process extends from three days for small anchors up to six days for large ones.

APPENDIX (B).

Series of Tests witnessed by the Committee at Newburn-on-Tyne Steel Works, 21st April, 1887.

On the arrival of the members of the Committee at Newburn, they were at once taken to the steel forge, where they witnessed the shank of a 27¾-cwt. anchor being heated in a gas furnace, for the purpose of being drawn down under a 2-toh hammer to the required size and shape. After passing through the steel foundry, where the process of moulding was noticed,



the members of the Committee went to the place set apart for drop-testing cast steel anchors. On the sketch appended hereto, A B represents a casting forming "shank and crosshead" for an anchor; this was gripped at its centre of gravity by a cramp C, so that, when suspended, the underside of A B was level. The disengaging hook D connected C temporarily to the hook E of a steam crane. This hook E was raised until a vertical staff 15ft. in length passed clear under B. A sharp pull at rope F liberated cramp C from the disengaging hook D, and A B fell free through slightly more than 15ft. on to a level steel slab, 9ft. by 5ft. 6in. by 1¼in. thick, lying solid on a cement concrete foundation, 10ft. by 6ft. 6in. by 2ft. 4in. thick. The spur H, previously partly disconnected from B by a sawcut at J, was then knocked off by some blows of a hammer. By a sling chain passed through hole G the casting was then suspended, and vigorously struck by a 10 lb. hammer over the length of the shank A. After a close inspection of A and B, the surveyor—in this case Mr. H. J. Boolds, of Lloyd's register, attended—if satisfied, has his private stamp marked in two places on A, and also in two or more places on the sawn end of spur H. This latter is cut up into one transverse test piece and—for every three anchors—one tensile testpiece. In a similar manner the two cast steel arms K and L were drop-tested. A sling chain took hold of both arms lying level, but in opposite directions, with the projecting parts or stops M M at the underside to prevent the sling chain being injured. The disengaging hook D took hold temporarily of ring N at one end of the sling chain. After having been raised until the vertical staff, 15ft. in length, passes clear under M, the disengaging hook was pulled, and liberated the two arms K and L, which fell on to the steel slab. Each arm was then separately placed on end, so that the palm was vertical and at the top, each part of the arm was then vigorously struck a number of blows with a 10-lb. hammer. The surveyor then closely scrutinised each arm, and, being satisfied, caused each arm to be marked in his presence with his private stamp in two places. In the manner described above, the following four cast steel anchors were drop-tested and stamped:—One 27¾ cwt., B 973, shank and two arms; one 30 cwt., B 975, shank and two arms; one 30 cwt., B 976, shank and two arms; one 25½ cwt. B 977, shank and two arms. The Committee were informed that the two arms in each respective case were cast at the same time and from the same ladleful of steel as the shank. The Committee next went to the fitting shop, and witnessed several transverse test-pieces, 1in. diameter and about 12in. long, being bent; one end was held fast in an anvil block, and the projecting end was then struck by two 10-lb. hammers until the test-piece was in each instance bent through the angle indicated in the tables appended hereto.

The Committee were then taken into the test-room, where a horizontal 100-ton hydraulic testing machine, made by Daniel Adamson and Co., approved by the Board of Trade in February, 1882, fractured a few tensile test-pieces. The shoulders or enlarged ends of the turned test-pieces were held in spherical washers, lying free in spherical cups, so as to ensure perfect alignment and avoid any twisting or bending. The fast block was suspended from a knife edge. The results of both transverse and tensile tests are appended hereto.

Tests Witnessed by the Committee.

Newburn Steel Works.—Test Office.

Cwts.	18	16½	32	27¾	30	30
Date of test, April 21st, 1887 ..	B 954	B 807	B 949	B 951	B 955	B 956
Mark of test	O 946	O 948	O 949	O 950	O 951	O 952
Size of specimen .. .. inches	·757	·757	·757	·757	·757	·757
Original area .. .. .. sq. in.	·450	·450	·450	·450	·450	·450
Fractured area .. .. ,,	·2551	·4185	·3318	·3019	·2375	—
Permanent set induced .. .. .. (tons per sq. in.)	14·88	14·38	14·88	15·87	14·38	14·38
Maximum strain .. ,,	29·26	21·82*	28·77	29·76	27·28	27·77
Contraction of area .. p. cent.	43·3	7	26·2	32·9	47·2	—
Elongation in length of 5in. ,,	26	4·5	16	17	27	28
,, ,, ,, ,,	—	—	—	—	—	—
Appearance of fracture, silky ,,	50	—	20	45	100	—
,, ,, fibrous ,,	—	—	—	—	—	—
,, ,, finely granular ,,	50	80	70	50	—	—
,, ,, crystalline ,,	—	—	—	—	—	—
,, ,, flaw ,,	—	20	10	5	—	—
	×					×

Remarks.—Test-pieces taken from cast steel anchors tested in the presence of the cast steel anchors Committee:—

	O 946, B 954,	Bent through an angle of	88°	Not broken.
	O 948, B 807,	,, ,,	70°	,,
	O 949, B 949,	,, ,,	65°	,,
	O 950, B 951,	,, ,,	85°	,,
	O 951, B 955,	,, ,,	87°	,,
×	O 952, B 956,	,, ,,	56°	,,

* *Note by Mr. Spencer.*—The low value of 21·82 tons maximum strain with 7 per cent contraction of area and 4·5 per cent. elongation in 5in. are explained by the flaw covering 20 per cent. of fractured area of test-piece. A slight flaw on the outside of test-piece, if it does not altogether vitiate the result of test, yet so affects it that, although the maximum strain may be attained, yet the elongation, owing to one portion of the cross-section of fracture not cohering at all, and thereby forming a starting point for fracture, is kept below that elongation which is due to the quality of the material, and the fracture takes place before the area of the test-piece has been reduced much below the original. In this and the following table the bottom line "flaw per cent" illustrates this in several instances, but the percentage of flaw does not necessarily correspond to the effect it exercises upon the contraction of area or the elongation, since much depends upon its position, whether this is central or one-sided or altogether at circumference of fracture. In the latter case the effect upon the test-piece is altogether disproportionate to the percentage of the flaw. In each of the above anchors, without exception, the transverse test-pieces gave satisfactory results.

Newburn Steel Works.—Test Office.

Cwts.	29	21	32	27½	32	27¾
Date of test, April 21st, 1887 ..	B 927	B 942	B 946	B 947	B 948	B 952
Mark of test	O 940	O 941	O 942	O 943	O 944	O 945
Size of specimen .. .. inches	·757	·757	·757	·757	·757	·757
Original area .. .. .. sq. in.	·450	·450	·450	·450	·450	·450
Fractured area .. .. ,,	·4185	·3848	·3117	·4185	·3959	·3739
Permanent set induced .. .. .. (tons per sq. in.)	13·39	14·38	15·87	15·87	14·38	15·87
Maximum strain .. .. ,,	28·48	29·76	28·77	27·28	27·28	28·77
Contraction of area .. p. cent.	7	14·4	30·7	7	12·02	16·9
Elongation in length of 5in. ,,	7	12·5	24·5	11	11·5	16
,, ,, .. ,,	—	—	—	—	—	—
Appearance of fracture, silky ,,	—	—	—	—	—	—
,, ,, fibrous ,,	—	—	—	—	—	—
,, ,, finely granular ,,	95	95	95	95	95	95
,, ,, crystalline ,,	—	—	—	—	—	—
,, ,, flaw ,,	5	5	5	5	5	5
					×	

Remarks.—Test pieces taken from cast steel anchors. Tested in the presence of the Cast Steel Anchors Committee:—O 945, B 952. Bent through an angle of 69 deg. Not broken. Four test pieces marked × were taken away by Mr. Boolds, surveyor to Lloyd's Register.

Foundations.—The first lecture of the session at the City of London College, in civil engineering, was given by Mr. Henry Adams, M.Inst.C.E., on Wednesday last, upon the subject of "Foundations." He said that when it was necessary to spread the pressure at the base of a wall, in order that some less resisting material below might support the weight of the superstructure, it would at first sight appear that, by using the bricks as all headers, footing-courses with projections of 4½in. might be adopted; but these would be apt to break off, a brick being most easily broken across its middle, and it was found that not more than a 2¼in. projection of each course beyond the one above it could be adapted as practically safe and at the same time convenient. This gives an angle of 53 deg. 3 min. from the horizontal for the line of transmission of the pressure, and shows that the ordinary allowance of 60 deg. in calculations leaves a slight additional margin of safety. Concrete has less bond than brickwork, and hence in lime concrete the projection beyond the base of the footings should not exceed two-thirds of the depths in running lengths; but in a square bed, as at the base of a factory chimney, additional support is derived from the corners, and the projection may be made equal to the depth. Less than this is liable to have a hole punched through it by the brickwork. In cement concrete the mass may be looked upon as homogeneous, and the projection made equal to the depth for running lengths, or 1½ times the depth for square beds. The least depth of foundations below the surface should be 3ft. in sand and 4ft. in clay to avoid the effects of frost. The following table was given, showing the maximum safe loads per square foot in foundations under ordinary circumstances, viz.:—Stock brickwork in mortar, 6 tons; cement concrete, 6 tons; hard gravel and deep solid clay, 5 tons; lias lime concrete, 4 tons; stone lime concrete, 3 tons; good gravel soil, 3 tons; ordinary solid earth, 1½ tons; bad ground, ¾ ton. The subject for next week is "The Use of Piling in Foundations."

Ironworks Practice and Steel Competition.—The growing competition of steel is a serious matter to the manufactured iron masters the kingdom over. Whether or not, they are to become extinct is a question which is quite open to debate. Under these circumstances any changes it is possible to introduce into the trade, with a view to prolonging the life of iron, must be doubly welcome to men whose capital is now locked up in mills and forges. Some valuable suggestions in this connection have just been put before the South Staffordshire Institute of Iron and Steel Works Managers, by Mr. H. Kirk, of Workington. This ironmaster believes that much may be done to enable ironmasters to accept prices that will give them a market, notwithstanding the increasing competition of steel if a larger production per turn of twelve hours is obtained in the forges. The practice in Belgium is to work nine heats in twelve hours, or if the workmen prefer, six heats in eight hours. In England the most that the puddler will work is six turns, and the great increase that must result in dead charges to the English maker is at once apparent. The weakest spot in the ironworks practice of to-day Mr. Kirk pronounced to be the small number of heats worked, and that weakness, he declares, must be as soon as possible removed. After great trouble he has got his own men to work seven turns, and he desires that they would work eight. Seeing that they are paid upon the tonnage produced, the system is in every way as good for the men as the old one, while the waste of iron in the furnace is less. Some extraordinary yields are being obtained at Workington by a judicious combination of science and practice. The average quantity of bar iron made per furnace per turn over last half-year was 35 cwt. 1 qr. 10 lb., of which 95 per cent. was puddled from pig iron. The possibilities opened up by the foregoing are worthy of careful consideration, though we fear that any proposed increase in the puddlers' heats would lead to determined opposition.

RAILWAY MATTERS.

On June 30th last 1419¾ miles of railway had been constructed in South Australia, at a cost, including discount on sale of bonds, of £9,419,917.

Mr. James Grierson, for many years general manager of the Great Western Railway, died on the 7th inst., in his sixtieth year. His funeral took place at Barnes Cemetery, Barnes Common, on Wednesday.

The *Revue* of Lausanne says, with reference to certain erroneous reports concerning the Simplon Tunnel, that the financial co-operation of Italy is absolutely necessary for the construction of the Simplon Tunnel, the entire project being based on such co-operation.

The Acadia Coal Company, of Nova Scotia, which owns another "oldest locomotive engine in the world," has made arrangements to ship it to Philadelphia, Pa., for exhibition in the industrial parade to be given as part of the celebration of the centennial of the adoption of the Constitution.

A telegram to the *North German Gazette* from Lulea, at the head of the Gulf of Bothnia, records the fact that the first train on the most northerly railway in the world passed the Arctic circle on Friday. The line has now been completed to within four Swedish miles of the famous Gallivara mountains.

Early on Tuesday morning a goods train on the Chicago and Atlantic Railroad ran into the rear of a passenger train at Kouts, fifty-five miles to the east of Chicago, and telescoped two coaches. The passenger train caught fire. Seventeen persons were killed or burned to death, and many were injured.

A correspondent, says the American *Engineering News*, "who has been stimulated by the late Chatsworth disaster to do a little quiet inspecting on his own account, and who so inspected the track in the vicinity of the Chatsworth trestle for a considerable distance, writes that he has found at least two other roads in the same section, and roads of much more prominence (we regret that he does not permit us to give their names), on which the track was in worse condition for long stretches than the unlucky road on which the tower of Siloam fell, while it came under his immediate observation that a special inspection of the structures on some three hundred miles or so of track, ordered by one of the great Chicago roads as a consequence of that disaster, was made from the rear platform of an accommodation train! Our space does not permit us to draw the appropriate morals."

Mr. Reckenzaun has succeeded in obtaining in New York a practical trial of a car fitted with his electro-motor. An American paper says:—"The American Electrical Car Company has for a long time successfully experimented with Mr. Reckenzaun's motor. The electrical cars have for some weeks been running on the Spruce and Pine-street rails, and now that Chestnut and Walnut-street have been invaded by the new motor, it will not be long before all the lines in the city are electrified. On October 19th a street railroads convention will be held in Philadelphia, when all the leading railroads of the United States will be represented. After this convention it is expected that the electric motors will become in general use on all the street railroads in Philadelphia."

A Board of Trade report by Major-General Hutchinson upon the three fatal accidents on level crossings on the London, Chatham, and Dover Railway, on the 8th and 25th of August and the 1st of September last, between Bromley (Kent) and Shortlands, concludes as follows:—"Notice boards were at each of the crossings. Although in each of the three fatal accidents that have recently occurred on the line there is little reason to doubt that ordinary caution on the part of the deceased persons would have saved their lives, it is nevertheless very desirable that the recurrence of such sad accidents should be prevented by the erection of foot bridges and by the closing of the crossings. It is possible that by the co-operation of the Local Boards of Beckenham and Bromley powers might be obtained to divert the footpath and close altogether the centre level crossing; but with respect to the waterworks and mill-pond crossings, which appear largely used by pedestrians, and over which some 170 trains pass daily between the hours of 5 a.m. and 1 a.m., I trust the London, Chatham, and Dover Railway Company will lose no time in substituting bridges for the crossings, and obtain the necessary authority to close the crossings."

The St. Petersburg correspondent of the *Times* states that M. Protsenko, the Military Governor of the Turgai region, has issued a pamphlet on the subject of the great Siberian railway, in which he discusses the questions of the best and shortest route, the practicability of such route as regards local conditions, the cost of construction, and the paying capacity of the railway. None of the routes hitherto proposed fulfils the conditions indispensable in the opinion of M. Protsenko. He offers a route selected by himself, which he strongly recommends as being most suitable. The following are the main points in this route:—Zlatoust, Tcheliab, Kurgan, the southern part of the Ishem district, Omsk, Tomsk, Krasnoiarsk, Bratsk Island, the northern *pristan* of Lake Baikal, the upper part of the river Oldoya or Ura, the Upper Amoor goldfields, the valley of the Ura, the middle part of the river Zey, Central Bureia, Little Khingan, Khabarofka, the Ussuri Valley, and Vladivostock. The cost of construction is estimated by the author of the project at 380,000,000 roubles. This amount is to include the cost of five large bridges, to be built for 6,000,000 roubles each. The term of building the line is to extend over five years, and the author proposes to obtain the necessary funds by the issue of interest-bearing paper at the rate of 76,000,000 roubles per annum. This capital, it is contended, could be easily obtained in the country, thus avoiding the necessity of resorting to foreign money markets. With regard to the future prospects of the projected line, M. Protsenko makes an approximate calculation that the receipts of the railway must be not less than 39,000,000 roubles in order to keep clear of guarantees. This amount, it is thought, will be easily realised.

The Congress of the Amalgamated Society of Railway Servants was concluded on Friday at Newcastle-on-Tyne. At the morning sitting the discussion was resumed on the Cardiff resolution protesting against the misapplication of funds by the executive committee in voting £35 each to 148 and to 41 Midland members—£6615 in all—besides other votes from the protection fund, in violation of the rules of the society. The resolution was rejected by 33 votes to 13. Resolutions were adopted as follows:—(1) Regretting the comparatively small progress made by the companies in fitting vehicles with brakes which comply with the conditions laid down by the Board of Trade as essential to safety, deprecating the action of companies who are now fitting their stock with continuous brakes which do not comply with the aforesaid conditions; (2) recommending the Board of Trade to amend the returns relating to the block system so as to give fuller particulars, such as showing which companies still make a distinction between the signalling of goods and passenger trains, and which of them issue regulations practically superseding the block system in addition to the caution or warning signals which are not set forth in the returns; (3) regretting that so large a number as 137 servants were killed and 1222 injured in shunting operations alone during the year 1886, and calling upon the various railway companies to adopt appliances known to be in existence; (4) recommending more practical tests as to eyesight, such as distinguishing signals, lamps, and flags under reasonable conditions; (5) approving the Railway Regulation Bill introduced into the House of Commons by Mr. F. A. Channing, M.P., and (6) urging the importance of preventing railway companies from contracting out of the Employers' Liability Act.

NOTES AND MEMORANDA.

It is said that the Chinese have utilised for centuries, in the evaporation of brine, a gas which issues from coal seams near Pekin.

The deaths registered last week in twenty-eight great towns of England and Wales corresponded to an annual rate of 17·5 per 1000.

It is stated that it requires 100 tons of twine to bind this year's crop on the great Dalrymple Farm in Dakota. This twine was shipped from Boston to Dakota by express, the charges being nearly 10,000 dols. The twine is valued at 20,000 dols.

In London last week 2647 births and 1265 deaths were registered. Allowing for increase of population, the births were 41 and the deaths 198 below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes, which had been 14·4 and 15·4 in the two preceding weeks, rose last week to 15·7. In Greater London 3442 births and 1572 deaths were registered, corresponding to annual rates of 33·2 and 15·1 per 1000 of the population.

A recent number of the *Comptes Rendus* contains a paper on "Researches on the Spheroidal State," by M. E. Gossart. The author here seeks to determine by calculation and experiment the meridional semi-section of any liquid drop whatsoever in a state of calefaction on a horizontal plaque. It is shown that there exists a characteristic form of the spheroidal state which may easily be represented graphically according to a given scale. The measurements of the various elements of these curves may furnish useful information on the capillary constant.

A paper was recently read before the Paris Academy of Sciences on "The Measurement of the Forces brought into Play in the Flight of a Bird," by M. Marey. Anatomy shows that nearly all the muscles acting on the wing serve to lower it, while the kinematic data drawn from photo-chronography show that during this lowering of the wing the mass of the bird is upheld against gravity and propelled forward against the resistance of the air, the result being flight. The author here studies these two elements of the motor power separately, whence may ultimately be deduced the sum total of the motor power.

One of the simplest barometers is a spider's web. *Nature* says that when there is a prospect of rain or wind the spider shortens the filaments from which its web is suspended, and leaves things in this state as long as the weather is variable. If the insect elongates its thread, it is a sign of fine, calm weather, the duration of which may be judged of by the length to which the threads are let out. If the spider remains inactive, it is a sign of rain; but if, on the contrary, it keeps at work during a rain, the latter will not last long, and will be followed by fine weather. Other observations have taught that the spider makes changes in its web every twenty-four hours, and that if such changes are made in the evening, just before sunset, the night will be clear and beautiful.

According to the report of Mr. William Crookes, F.R.S., Dr. William Odling, and Dr. C. Meymott Tidy, the amount of organic matter in the water supplied to the metropolis during September was exceedingly small, the results recorded day by day being marked by great uniformity. Thus the organic carbon in the Thames-derived waters was, on an average of numerous samples, 0·125 part per 100,000 parts, the oxygen required to oxidise the oxidisable matters present in the water being about $\frac{8}{100}$ths of a grain per gallon. The colour, moreover, of the water, as shown by the colour meter, was excellent. A few samples of the East London Water Company's supply were recorded as "very slightly turbid." This condition, however, in no respect interfered either with the general purity or with the wholesomeness of the supply. Without exception, the condition of the water supplied to the metropolis during September was entirely satisfactory.

The readiness with which chromium oxidises has suggested the use of ferro-chrome instead of spiegeleisen as a recarburiser for the Bessemer process. But Mr. H. M. Howe, in the *Engineering and Mining Journal*, says its efficacy is very doubtful. The oxides of manganese arising from the reaction between the oxygen of the blown steel and the manganese of the spiegeleisen are fusible and scorifiable; they coalesce and rise to the surface of the molten metal. Chrome oxide, infusible and well-nigh unscorifiable, would probably remain mixed with the steel, break up its continuity and impair its forgeableness. Indeed, even in the crucible process, in which chromium has comparatively little chance to oxidise, chromic oxide, formed while the steel is molten, is liable to cause deep ineradicable veins in chrome steel, especially if its carbon be low or its chromium high. Even in heating chrome steel a very strong and adherent scale forms, which renders welding next to impossible. Chromium is said to hasten the rusting of iron.

An approximately correct method of calculating the available quantity of coal in a given area of a seam is, according to Mr. C. M. Percy in the *Indian Engineer*, to consider an area of coal 1in. thick as containing 100 tons, and this will allow a sufficient margin for faults and loss. Calculated in this way, a seam of coal 24in. thick will yield 2400 tons to each area. But to ascertain the exact quantity of coal under a given area, we must first know the specific gravity, then knowing the weight of one cubic foot, the rest becomes a mere matter of calculation. Taking the specific gravities—water being 1·0 and weighing 1000 ounces per cubic foot—as 1·10, 1·15, 1·20, 1·25, 1·30, 1·35, 1·40, 1·45, 1·50; we have the following weights in the natural bed per acre per inch thick in tons:—111·411, 116·475, 121·540, 126·604, 131·668, 136·732, 141·796, 146·860, 151·925 and the weights of a cubic foot in the broken state in pounds will be of large coal—42·62, 44·56, 46·50, 48·43, 50·37, 52·31, 54·25, 56·18, 58·12; and for small coal—37·12, 38·81, 40·50, 42·18, 43·87, 45·56, 47·25, 48·93, 50·62. In measuring heaps of coal in England it is customary to allow 45 cubic feet to one ton.

The Board of Trade returns for September show that iron and steel were exported to the value of £2,304,573, against £1,716,089 and £1,934,390 for the corresponding months of 1886 and 1885; for the nine months the total values for each year are—1887, £18,579,845; 1886, £16,388,229; 1885, £16,510,298. Hardware and cutlery were exported during September to the value of £267,629, against £255,257 for September of last year. There is thus a gain on the month; but the statistics show a loss on the year to date of £10,000. Pig iron has been sent abroad to the value of £293,417, against £230,561, the respective values for the nine months of 1887 and 1886 being £2,113,229 and £1,722,464. Bar, angle, and bolt, £133,745 (last year £106,541); for the nine months of 1887, £1,046,053; 1886, £992,210. Steel rails, during September, £334,665 (September, 1886, £225,794); for the nine months of 1887, £2,452,044; for the nine months of 1886, £1,865,988. In railway material of all sorts the value exported last month was £454,638, against £308,900 for September of 1886; for the nine months of 1887, £3,372,123; for the nine months of 1886, £2,919,593. Hoops, sheets, and plates, £329,972 for last September, and £233,745 for September, 1886; for the nine months of 1887, £2,408,952; for the nine months of 1886, £2,296,639. In steel (unwrought) there is also an important improvement, chiefly in the United States market. For the month the value of steel exported was £163,050, against £136,106; for the nine months, £1,639,050, against £975,621. The United States has advanced from £347,688 in the nine months of 1886 to £957,777 in the corresponding period this year.

MISCELLANEA.

The first meeting of the Society of Telegraph Engineers' winter session will be held on the 10th November, when a paper will be read "On Deep Sea Soundings in Connection with Submarine Telegraphy," by Edward Stallibrass, F.R.G.S., Member

Supervising Inspector General Dumont has decided that the hull and boiler of every yacht or other small craft propelled by steam in the States, without regard to size, provided it can be used in navigation, must be inspected. The pilot and engineer must also be licensed.

The Brussels correspondent of the *Times* says the Belgian engineers who have been at work on the Panama Canal express most unfavourable opinions as regards the position of the enterprise, and consider the difficulties still to be overcome as almost insuperable.

It has been stated that "the Japanese are about to supply themselves with machine made bricks. They have ordered from a German firm machinery capable of turning out 16,000,000 bricks yearly." We are, however, informed that Messrs. Bradley and Craven, Wakefield, have just supplied a plant for turning out 10,000,000 bricks yearly.

The great English coal shipping ports are in order of magnitude:—Cardiff, Newcastle-on-Tyne, Sunderland, Newport, Shields, Swansea, Liverpool, and Hartlepool. Cardiff and Newcastle are nearly equal, and account for more than half the total. Cardiff does the largest foreign trade, and Newcastle the greatest home trade, Sunderland running very close.

The improvements in the "Rider" hot air engine patented by Mr. J. C. R. Okes, and which are illustrated in our number of 21st January, 1887, have been adopted by the sole makers, Messrs. Hayward Tyler and Co., who have just supplied ten engines of the new type to a foreign railway company for outlying water stations where skilled labour is scarce; one is also being put up at Girton College, Cambridge, to the order of Mr. Alfred Waterhouse, for the new wing.

The Commission entrusted with the investigation of the question of women's and children's work in Dutch factories, has recommended that young people under the age of sixteen shall not be employed. It is also proposed to introduce partial restrictions as to the employment of those under eighteen, together with a provision for two hours' rest in the day. The Commission moreover advocates the enactment of laws for ensuring the safety and health of the employed, the appointment of factory inspectors, and the adoption of measures for the assistance of workpeople and their families in cases of death, illness, old age, or accident.

Everyone knows that the common hand saw was invented in America, and now any doubt as to the first circular saw is set at rest. "Captain William Kendall, of Waterville, Me., was, the *Industrial Journal* says, the inventor of the circular saw, in 1820. The saw was made of iron plates rivetted together, and was five feet in diameter; the teeth were of steel, and inserted in the outer edge of the saw, secured by rivets. Captain Kendall also started the first planer ever run, by inserting cutters in the body of the saw so that as the saw revolved and cut the board it also planed it. The writer of this was an eye-witness, not only of the construction of the saw, but also of its revolutions. The head and foot blocks were provided with an apparatus for setting the log automatically when the carriage was run back, much as a shingle machine of the present day. The log was also turned on the carriage by machinery."

The syllabus of the Dundee Mechanical Society for the Winter Session includes papers as follows:—November 10th, "Ocean Currents," by Mr. James Aimer; November 24th, "Jute and its Recent Development," by Mr. Thos. Ferguson; December 22nd, "Shipwrecks and Salvage Work," by Mr. Thos. N. Armit; January 12th, "The Use of Brass in Mechanical Engineering," by Mr. A. L. Peacock; January 26th, "Health," by Mr. James B. Mason; February 9th, "Flax, Hemp, and Jute Culture," by Mr. D. J. Macdonald; February 23rd, "Coal Mining," by Mr. Geo. Worrall, jun.; March 8th, "Milling Tools," by Mr. John R. Stewart; March 22nd, "Inventions;" April 5th, "Essay," by Mr. Duncan Ferguson; April 19th, "Specialties in Mechanism," by Mr. G. Stevenson, jun.; May 17th, "Election of Office-bearers." The following prizes will be given for competition amongst ordinary members:—One prize for the best paper read before the Society during the year; one prize for the best criticisms of the various papers delivered.

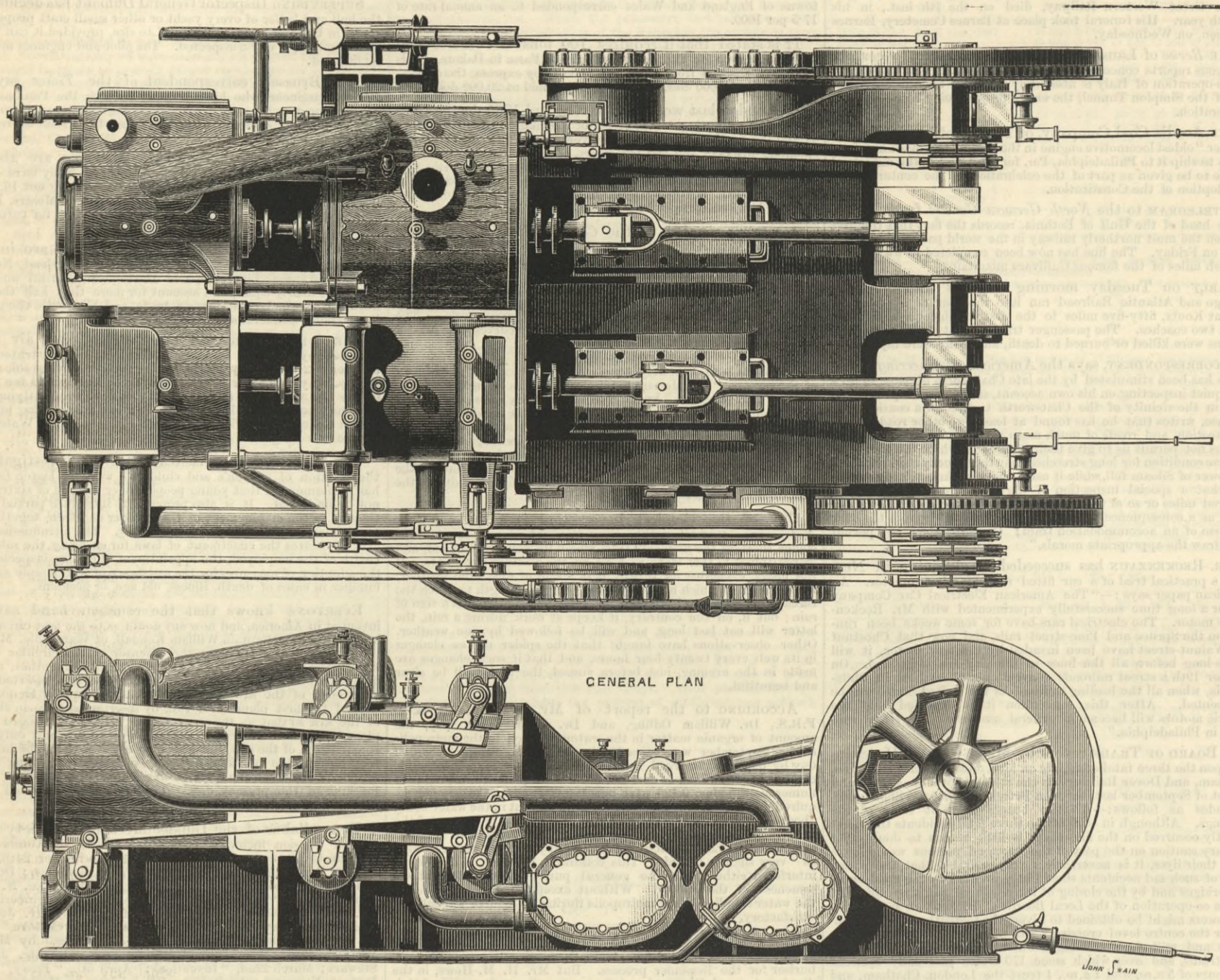
Mr. Thomas Routledge, the well-known paper maker, whose death took place at the Westminster Palace Hotel, on Saturday, the 17th ult., was not originally a paper maker, but in 1856 he took a mill at Eynsham, near Oxford, where, after obtaining a patent, he succeeded in making paper from esparto grass. The number of the *Journal of the Society of Arts* for November 28th, 1856, containing Dr. Forbes Royle's paper on "Indian Fibres," was printed on paper made from esparto at Eynsham Mills, and supplied by Mr. Routledge. About 1862 he acquired the Ford Paper Mills, near South Hylton, Sunderland, and in 1864 he converted the business into a company, under the title of the Ford Works Company, of which he continued to be the managing director down to the time of his death. For some years he was the only paper manufacturer in England who used esparto, but after a time it came into general use. The amount of the imports in 1856 was only fifty tons, but by 1864 it had grown to 50,000 tons, and in 1886 the imports exceeded 200,000 tons. Mr. Routledge succeeded in proving the suitability of bamboo as a paper-making material, and published a pamphlet on the subject in 1875, which was printed on paper made from bamboo.

One of the subjects discussed at the annual meeting of the French Association for the Advancement of Science, which has just been held at Toulouse, was the project for making a maritime canal between Bordeaux and Narbonne. The different phases of this project, which was first mooted twenty years ago, were passed in review by M. Wickersheimer, Deputy for one of the departments through which the canal will pass. The latest project was prepared this summer by a company which has been formed for the purpose of making the preliminary survey, and according to this scheme the canal, which would be about 330 miles in length from sea to sea, would start from the western side of Bordeaux and follow the left bank of the Garonne for a distance of fifty miles, crossing that river at Castel-Sarrasin by a *pont-canal* (or aqueduct) and follow the right bank of the river as far as Toulouse, where a large port would be created. From Toulouse to the Mediterranean seaboard at Narbonne, the maritime canal would be quite independent of the railway from Bordeaux to Cette, but it would twice cross the Canal du Midi. The curves of the canal would be of the same radius as those in the Suez Canal—that is to say, not less than 6000ft., and there would be thirty-eight locks, the fall of which would range from 20ft. to 30ft. The depth would be about 24ft., but if the Minister of Marine should determine to make use of it for the first-class ironclads of the French navy, contrary to what was originally determined, the company will be prepared to make it 3ft. deeper. It is estimated that the mean speed of vessels passing through the canal will be seven miles an hour, and they would be drawn by locomotives running along a line of rails placed on the banks, a force of from 1000 to 1200-horse power being required to produce this rate of speed. The canal is to be lighted by electricity, the electric light being generated upon the engines used for the traction of the vessels. The total cost is estimated at £26,000,000, or less than half of the estimate originally prepared. The distance saved for vessels coming from the western ports of France into the Mediterranean would be 680 miles,

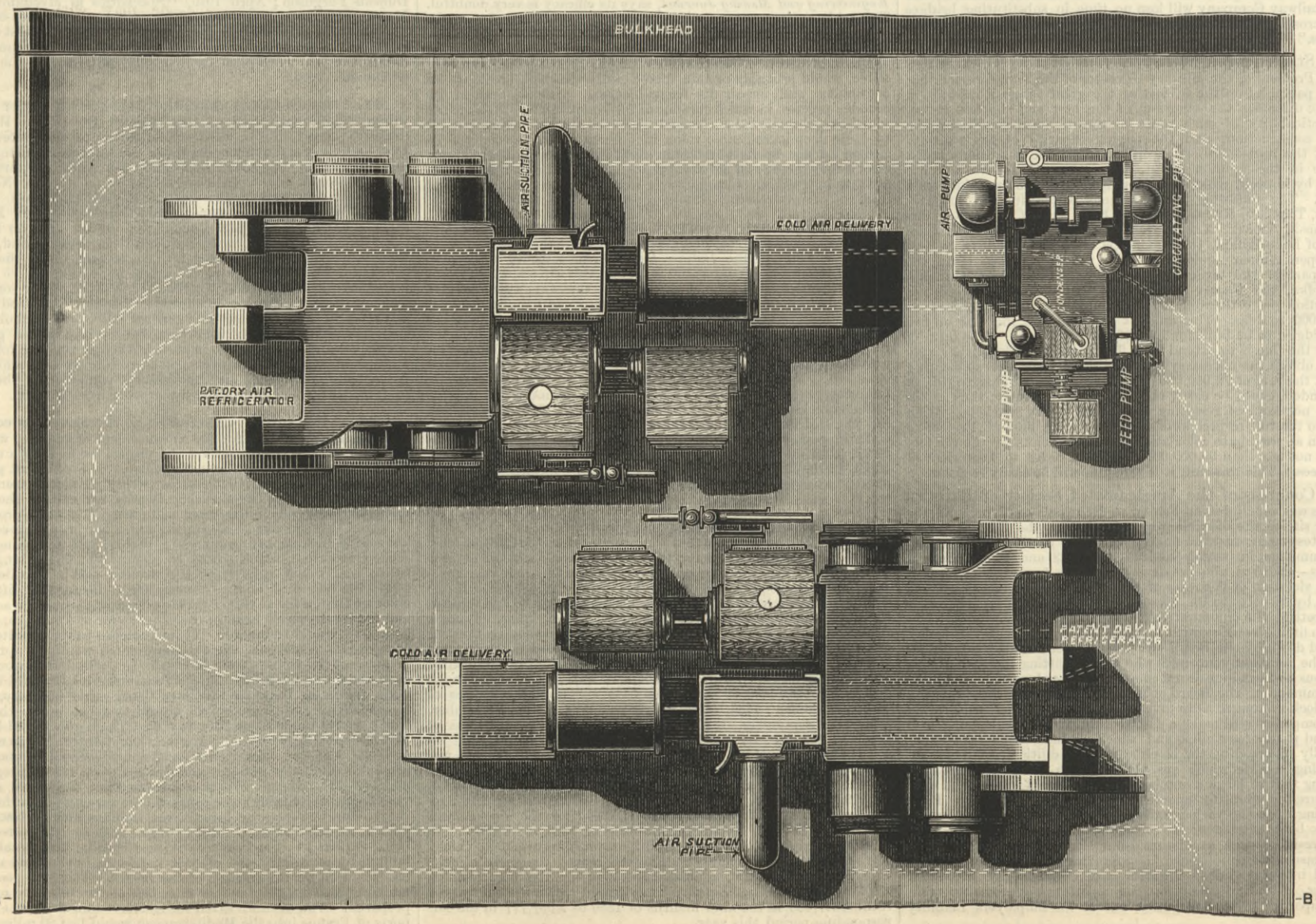
REFRIGERATING MACHINERY, S.S. FIFESHIRE.

MR. T. B. LIGHTFOOT, LONDON, ENGINEER.

(*For description see page 305.*)



GENERAL PLAN



FOREIGN AGENTS FOR THE SALE OF THE ENGINEER.

PARIS.—Madame Boyveau, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Messrs. Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—The Willmer and Rogers News Company, 31, *Beekman-street.*

CONTENTS.

TO CORRESPONDENTS.

Registered Telegraphic Address "ENGINEER NEWSPAPER, LONDON."

*** *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.*

*** *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* 1*d. 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.*

Wales.—*Herren Schmidt and Bichel, Carbonitfabrik, Schlebusch, Rhein Preussen, Germany.*

Mushett.—*Perhaps "Ainsley's Engineer's Manual" will meet your requirements as much as anything of the kind. There are several books known as engineers' handbooks to the Marine Board Examinations, and there is a little book, "The Engine-room: who should be in it and what they should do."*

M. Bros. (Seatle).—*We have not published any special book on marine engines, but in the pages of* The Engineer *you will find all the best modern marine engine practice fully illustrated and described. We could make a selection of such copies as are most likely to interest you and are in print, and send them to you, if you think proper.*

SUBSCRIPTIONS.

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

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

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

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

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

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

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

ADVERTISEMENTS.

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

Advertisements cannot be inserted unless Delivered before Six o'clock on Thursday Evening in each week.

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

MEETINGS NEXT WEEK.

North-east Coast Institution of Engineers and Shipbuilders.—The annual general meeting of the Institution will be held in the Lecture Hall of the Literary and Philosophical Society, Newcastle-upon-Tyne, on Wednesday, October 19th, at 7.45 p.m. The Council will submit its report for last session; financial statement. The President will deliver his inaugural address. The Council has arranged that the following papers shall be read and discussed during the session:—November 9th, in Sunderland: (1) "Speed and Coal Consumption of Steamers Treated Commercially," by Mr. Robert Thompson; (2) "Notes on Speed Calculations of Steamers," by Mr. G. Arnison, jun. December 7th, in Newcastle: "Improvements in Ships' Keels, Stems, Sterns, and Rudder Frames," by Mr. E. F. Wailes. January 11th, 1888, in Newcastle: "On the Combustion of Coal, and some Evaporative Experiments with Natural and Forced Draught," by Mr. W. Spence. February 8th, in Newcastle: "On Slide Valve Gears," by Mr. J. T. Milton. March 14th, in Sunderland: "On Stockless Anchors," by Mr. G. W. Sivewright. April 11th, in Newcastle: "On the Construction of Pontoon Dry Docks," by Mr. A. Taylor. May 9th, in Newcastle: Closing business meeting.

DEATHS.

On the 7th, at Great Marlow, James Grierson, general manager of the Great Western Railway, in his sixtieth year.

On the 8th inst., at Belvidere, Kent, William Macgeorge, C.E., London, in his sixty-eighth year.

THE ENGINEER.

OCTOBER 14, 1887.

INDIAN COAL AND ITS STORAGE.

The announcement just made that the Peninsular and Oriental Steam Navigation Company has entered into a contract for the supply to the vessels of its fleet of a large quantity of Indian coal, directs attention to the growing use of native-raised coal in our Eastern Possessions. The report lately made by Mr. Jones, Assistant Superintendent of the Geological Survey of India, as to the deposits of coal in the Kali coalfield, on the Chindwin River, in Upper Burmah, has also a wide bearing on this important subject. Mr. Jones states that the field is merely a small portion of what promises to be a much larger field; coal, according to his report, occurring along most or all the streams flowing into the Chindwin on the right bank. The new fuel is said to be of fair quality, and the position, on account of the waterways, is favourable for working. Experiments made with this coal on board of the river steamers have resulted satisfactorily; but it possesses, in common with most Indian coal that has come under our notice, the defect of friableness. That defect is one which may disappear as deeper workings are reached. The ill-effects of the intense sun of the tropics even on the best English coal are well known. Exposure to its rays through countless ages may well have caused deterioration, or perhaps imperfect formation, in the upper strata, defects which may become less and less apparent as greater depths of the deposits are reached.

It has long been an axiom that for marine purposes Indian coal is far inferior both for steam raising and in an economical sense to the English coal usually consumed in steamer's furnaces. Its steam-raising quality is said to be about but two-thirds of that of English coal. Hence it would follow that steamship bunkers must store one-third more of Indian than of English coal. This fact, of course, would mean a large sacrifice of tonnage; and we may be sure that the Peninsular and Oriental Company would scarcely consent to such a sacrifice at a time when the exigencies of competition demand the power of freight carrying to the utmost possible limit. The question, then, must present itself whether the deeper working of Indian coal due to the exhaustion of available surface material has not brought about that improvement in quality to which we have above referred. The result of inquiry seems to show that such is the case, at all events in some of the collieries of one of the largest of our Indian coal companies, and it may be accepted, we think, that the proportion of two-thirds comparative value can no longer be considered as accurate data to go upon in estimating the relative efficiency of native-raised as compared with imported coal. It must, however, be long before the balance is fully turned in favour of the extension of the use of the former supply. English coal is now being sold in Calcutta at seventeen rupees the ton. Allowing for the present depreciated value of the rupee, this sum would represent about 25s. 6d. of English sterling money. We understand that the Bengal Coal Company finds it impossible to place native coal from its stores at Raneegunge in Calcutta much under 25s. the ton. The margin of difference in cost is therefore at present far too trifling to make up for the as yet established superiority of English coal.

But that margin may not improbably be largely increased in favour of native coal ere very long. The present condition of the eastern shipping trade compels owners to accept outward freight at almost nominal rates. In many instances, indeed, it is shipped as ballast for the outward journey. A rise in freight of but a few shillings the ton would alter this condition most materially, and the economical advantage would then be transferred to locally raised supplies. With the prospect now apparent of a largely increased area of coalfield becoming available in our eastern dominion, the possibility of such transfer of advantage becomes most important. We know of many coalpits in India already opened, but the working of which is delayed until the extension of railways enables their future output to be conveyed to a market. Each day almost must, therefore, bring us nearer to a large increase in the available supply of native coal, and, assuming that deeper sinkings may improve its quality, we may expect to see our home export of the article to eastern countries most sensibly diminished. But there is a second side to the general question of our Indian coal supply which has yet to be considered, and there can be no disputing that upon its satisfactory answering must largely depend the result to the competition between native and English coal above discussed. We have referred to the friableness of Indian surface coal. This defect, as we have stated, will probably soon disappear; but it will be re-created if, after the coal has been raised to the pit brow, it is stored for any length of time in the open, exposed to the deteriorating effect of the sun's rays. What the amount of such effect is is well known to all who have had to deal with large quantities of coal, either English or native, in tropical countries. We have heard of the first description, imported for use in locomotives, wasting to the extent of 40 per cent. in little over six months. It was only the hearting of the mounds which could be got to burn freely. The dusty stuff, which could not be used for brick burning, choked tubes and did other mischief which determined that no further trial should be made with it.

It is evident, therefore, that coal which has long to await dispatch must either be stored under cover or will have to be sent to market in a highly friable state. English coal is delivered from ships' holds and used up almost as soon as unshipped, free from the effects of the influence we have named. To meet this further element in the competition, coal raised locally and having to be held in hand must be housed under shelter. The cost of doing this must necessarily sensibly affect the balance in the competition. However freely the mounds of coal stored in the open may be kept watered, the combined influences of sun and strong winds soon deteriorate it. Much might, we think, be done in the direction of more scientific methods of watering than those at present employed. It should be done almost in the form of rain distributed from fine and numerous roses. A *splash* of water on heated coal already rendered friable but hastens its decomposition. This is one point out of many which have to be considered and dealt with if the native coal production of India is ever to successfully compete with that of English importation.

BRITISH INDUSTRIES AND TECHNICAL EDUCATION.

Those most anxious for the supremacy of British industries must regret the line of argument taken by the leaders in the technical education movement; because weak arguments impair the prospects of the thing they advocate, and technical education is a very important and a very necessary branch of learning for those who have to earn money by the exercise of technical knowledge. The capability of earning money must, of course, be regarded as the index of the value to a commercial and industrial nation of any kind of technical education. Those who pay for instruction of this kind for pleasure need not be considered; and it is not sought as a means of culture. The value of the education with which we have to deal is, then, its value as a means of making money, however disagreeable that plain way of stating it may be. It is a proof of this truth, that the modern leaders, in the clamour for technical education, base their claims for its value on its supposed worth as the means of preventing trade depression, and as the means of placing Great Britain at the head of the manufacturing nations of the world. It is urged by them that some foreign nations are passing us by in the industrial race for wealth, and that the reason for this, the aids by which they have broken through our supremacy, are those obtained through technical education.

To say that the continental system of technical education has absolutely no connection with the growth abroad of what have long been British industries, would be merely making a statement which, however true, is weak without proof. Proofs are not wanting, and in fact they are overwhelming. To deal with only a few would occupy much more space than we can give, but we may touch on some, and in the first instance must inquire what are the industries that have been affected by this foreign competition. As for the manufacturing industries, we shall find cotton spinning and weaving, iron and steel tubes, wire, glass goods, and Belgian rolled joists; but for a great cause of depression resulting from competition we must turn to agriculture and to the foreign wheat. It is a waste of time to talk on generalities—we must take actual instances if we would arrive at any truth.

Taking first the cotton trade, we find that we are dealing with what is now an old industry, one which has been established long enough to have ceased to be the subject of much new invention—an industry which has become sufficiently settled to afford a safe investment for the foreign capitalist, not only in the use of machinery, but in its manufacture. Having merely to adopt a prepared industry, the foreign manufacturer has necessarily made some few improvements, and has devoted some special attention to highly finished products. He has fairly embarked in a trade in which any one may embark who has the capital, and he may with his products enter the same markets or any new markets he can find. But why does he occasionally obtain trade where British manufacturers used to have the monopoly? Simply—apart from political causes—because he occasionally offers something with a new pattern, or of slightly new character, or because he can sell these things at a slightly smaller price. Such influences have, however, very brief effects, and as far as new patterns or make of stuffs are concerned, are just the same as, and of no more significance than, the extra trade done by a confectioner or biscuit baker for the time that he has a new biscuit that others have not yet made. Any industry that remains long without radical changes, and which becomes the common property of every nation that likes to take it up, is bound to be subject to these occasional advantages on one or another side, but they have not the remotest connection with technical education, or if they have, then the British manufacturer is best educated, for the advantages are even yet most often on his side, and English cotton spinning and weaving machinery makers turn out more machinery than all the rest of the world, if we exclude America, and even now send it in large quantities to continental purchasers. Theprice of cotton goods is the leading factor in trade, and why can the continental manufacturer occasionally undersell the British? The answer is chiefly that the foreigner pays less to his workpeople for the work they do, certainly not that education enables them to make better use of his machines, or more out of a pound of cotton. In his inaugural address, delivered in the University of Edinburgh, Professor G. F. Armstrong mentioned that in the Paris Exhibition, 1867, Great Britain, as far as awards showed, excelled in only ten of the ninety departments, and he says, "to the question, 'What has enabled you to gain the signal victory over us which it betokens?' the Continent, with one voice, replied, 'our systems of general education and the training of our technical schools.' Many of our workmen saw the truth with equal clearness, and one despondently said, 'The workmen of other countries have a far superior education to ours, many of whom have none at all. Their productions show clearly that there is not a machine minding a machine, but that brains sit at the loom and intelligence stands at the spinning-wheel." This is very pretty, but it means nothing practically, and tells nothing concerning the value of the education of those countries, for the brains that sit and the intelligence that stands at those looms might just as well not be there if the only outcome of their presence is lower wages than the people of England obtain. Lower wages to workpeople do not signify advantage to the country, and were it not for other conditions which affect the cost of living

the workpeople in those countries would soon make use of the brains, and the intelligence too, and obtain correspondingly more pay. Just before Professor Armstrong made the remarks above quoted he had mentioned that, in 1851, "Great Britain was awarded the palm of excellence in nearly all the grand departments—100—of the Exhibition." He probably intended to say that this was the result of superior British technical instruction, but he did not, so presumably we must conclude that if the facts mean anything, they mean that we had lost about nine-tenths of our cunning in the sixteen years that passed between 1851 and 1867. If Great Britain excelled in about one-ninth of all the departments of a Paris Exhibition, while France, Germany, Belgium, and Italy excelled only in the little that was left after Great Britain took "nearly all" in the London Exhibition, it would seem to an ordinary observer that Great Britain had not done so badly; but this, of course, is not the way to look at it. The truth is, that the brain that sat and the intelligence that stood at the looms were brain and intelligence that only occasionally sat or stood there, and they were the possession of the intelligent foreman or manager, in whose technical instruction weaving had probably not found any place. It may also be pointed out that the awards at Paris were pre-arranged by the politician, each friendly nation to have its share.

If we turn to the wire-making industry, in which German manufacturers became such very strong competitors, we may quote the inaugural address delivered by Professor Hele Shaw in the University College, Liverpool, who, in mentioning the lower wages which count to the advantage of the foreign competitor, said: "In the neighbouring industry of wire drawing at Warrington, which was threatened with extinction, the German competition was entirely met and overcome by the wire-workers voluntarily accepting a reduction of 10 per cent. after four of their delegates had visited the Black Forest and obtained for themselves full particulars as to the wire industry of that district." Here, again, is evidence that although Germany is a very much educated country, the low wages the men are paid is the chief or only cause of the successful German competition. It cannot be pretended that the low wages are the effect of the wide-spread education; or that the better educated workmen of Germany can either earn more money or make better wire than the British workman who is credited with very little knowledge.

If we turn to the glass manufacture we find the same thing. English-made table ware is still the very best, and fetches a higher price than the continental goods; but for the ordinary and the common table goods the English manufacturer has no chance against his German adversary, for the workmen of the latter work for lower wages, for longer hours, and keep the plant fully employed, whilst the English glass makers work only when they think they will, the furnaces and pots usually standing idle from one to two days out of six. The workmen are the slaves of a union, which will only allow them to make, even if they wished otherwise, a certain quantity per week; and will only permit a very small number of apprentices, and even then the master has to allow the men a certain sum on the work of each apprentice when he acquires the ability to turn out good work. These facts are amongst those that explain the successful competition of the German glass manufacturers. The Belgian and German iron and steel trades chiefly owe their very partial successful competition against ours in some markets to the low wages paid and to more favourable transport rates; and the Belgian joist trade, about which so much was said, was after all, from British iron manufacturers' point of view, a small thing, and as soon as it was worth spending capital upon it, they invested the necessary amount in plant for the purpose, and now these joists are not obtained in Belgium to any noteworthy extent.

The truth is that the proposed universal technical education is not likely to be of any real service, and that what is really wanted is, as Professor Shaw says—quoting the aims of the Association for the Promotion of Technical Education—"A reform in our system of national education with the object of giving it a more practical direction," or "to effect such reforms in our educational system as will develope in the best way the intelligence of those of all classes upon whom our industries depend." This is true in a general sense, but the questions arise, what are we to call education with reference to industries, and on what classes do our industries depend? Taking the second question first, it would seem that the answer is primarily upon the leaders—upon those who originate new and important industries, for the working men depend on these. On those who originate and develope the applications of labour all depend in the manufacturing race for supremacy. Their education is of the utmost importance, and there is not the least doubt that our colleges are doing good work in this direction; but it must be remembered that it is possible to neglect the most important part of their education, namely, that which they should obtain by lengthy experience in the workshops. The school and college part of their education may be immediately improved by giving it "a more practical direction," but this must be by omitting much of the purely literary instruction, so as to leave a sufficient time for personal experience of industrial methods and processes, and of commercial experience. It must not be thought that competition in the great labour-employing industries can be reduced by acquisition of the technical education of the kind talked of in the recent Bill before Parliament. Trade goes chiefly to those who can most cheaply produce well-known commodities, or who have something to offer which is desirable, and which cannot be obtained elsewhere; just as it came chiefly to England in cotton and other manufacturing trades before the other countries had learned them from us. Important as is the improvement in the education of those who are to enter on industrial and professional occupations, it must be remembered that National Technical Education is no sovereign remedy for depression in manufacturing industries any more than it is in bread-making or wheat-growing, and too much dependence upon it will do infinite harm, especially if it produces men whose capacity is injured by giving it the grooviness of the schoolmaster or the fear of departing from beaten tracks or incapacity to do so.

We cannot touch upon the prime importance as a main factor in home trade depression of the fall in the value of wheat as produced by protective duties in America and the fall in the value of the rupee outside India; but we may quote a contemporary, who says: "One thing at least is certain, namely, that England's commercial and industrial supremacy is inseparably associated with her political ascendancy, and when the one decays the other will go after it. We may not be able to predict which will go first, but assuredly we shall not save both, and consequently not either, by any brand new schemes of education, however valuable intrinsically those schemes may be." We may also call attention to the remarks on technical education in Germany, and of the awakening in Germany to the value of English high appreciation of the practical part of education, as referred to in the letter of our German correspondent in our impression of the 30th ult., p. 280.

HOT-WATER CYLINDER JACKETS.

Although large numbers of engineers maintain that jacketting the cylinders of steam engines is essential to economy, faith in their efficiency is by no means universal. Many men of great experience hold that they are of little or no use. Even those who most strongly advocate their universal adoption are not unanimous as to the method of their application. Some persons hold that only the high-pressure cylinder need be jacketted; others say that the high-pressure cylinder may be left to take care of itself, but the low-pressure cylinder must be jacketted. This diversity of opinion arises no doubt from the conflicting results of experiments, and the circumstance that the more efficient in one sense the jacket is, the greater, on the other hand, is the quantity of steam liquefied in the jacket. If no liquefaction took place, or if the steam liquefied could be had for nothing, then there would be no dispute. As matters stand, it is not an unusual thing to find an engine using 18 lb. of steam per horse per hour. Of this quantity, about 2 lb. is condensed in the jacket. If the engine without a jacket got on with 18 lb., then it is clear that it would be a cheaper and so far better machine than the engine which used 16 lb. per horse per hour in the cylinder and 2 lb. in the jacket. Nay, further, if the engine without the jacket used 20 lb., it might still be the better machine of the two. Two pounds of steam represent, let us say, one-fifth of a pound of coal. Taking coal at 10s. a ton—a high price—the value of one pound is ·0535 of a penny. Roughly speaking, therefore, the value of the jacket under such circumstances is represented by the hundredth part of a penny per horse-power per hour, or one penny per hundred horse-power, or say, 10d. per day, or, for 300 working days, £12 10s.—a very insignificant sum compared to the whole cost of running an engine developing 100-horse power. If we deduct from the £12 10s. saved the interest at 10 per cent. per annum on the extra cost of the jacketted engine, it will be seen that the margin is yet further reduced.

Several years have now elapsed since in the pages of this journal we suggested a system of jacketting which would effect a clear saving. It is obvious that if a high temperature could be maintained in the jacket without condensing steam in it, or if the jacket could be kept hot by heat which would otherwise be wasted, then a distinct and valuable economy would be effected; and we proposed to secure this end by circulating water at a high temperature in the jacket, the water to be heated by pipes in the smoke-box or flues beyond the boiler. So far as we are aware, nothing has been done in this direction in England, most probably because there was no patent connected with it. Although any one who pleased could take out a patent for the details by which the principle was carried into practice, it is more than doubtful if the heating of jackets with water instead of steam would in itself form a subject for a valid patent. The last number of the *Revue Universal des Mines* contains a short paper describing the application of the principle in practice in Italy, and with results which fully bear out all our anticipations. Signor Guzzi, an Italian engineer, it seems, deposited with the College of Engineers and Architects at Milan a note suggesting the use of steam of a very high temperature in jackets. No opportunity occurred for putting the idea into practice until recently. At the beginning of 1886, however, he was enabled to fit up an engine at the electric light works of M. C. Rivolta and Co., of which Signor Guzzi is technical director. The principle is carried into practice in the following way:—Under the boiler furnace is placed a system of pipes constructed on the Perkins oven system; these receive the flame through a passage fitted with a damper. The pipes are termed a "thermo-syphon," and communicate with the cylinder jackets by means of two pipes, one to lead steam at a high temperature to the jackets, the other to return the condensed steam back to the thermo-syphon. A small pump is provided to make good any waste. The thermo-syphon is fitted with a safety valve loaded to 225 lb. on the square inch. A cock is provided to clear out air, and either boiler steam, or that from the thermo-syphon can be admitted to the jackets. The apparatus has now been in regular work for eighteen months, and the results are pronounced to be perfectly satisfactory. Out of a large number of experiments Signor Guzzi has selected two of the least favourable. One run was made on the 24th of February, 1886. The engine worked to 26-horse power indicated. The boiler pressure was 55 lb.; that in the jackets was 180 lb. The run lasted 6 hours 18 minutes, and the consumption of steam was 19·53 lb. per indicated horse-power per hour. On the 27th of February a run was made of 7 hours 11 minutes, the boiler steam at 55 lb. pressure being admitted to the jackets, the thermo-syphon not being in use. The engine indicated nearly 26-horse power, and the consumption of steam was 23·47 lb. Signor Guzzi suggests, furthermore, that instead of water, oil or some fluid with a high boiling point should be used in order to avoid the use of extremely high pressures. Furthermore, he expressly bases the efficiency of his apparatus on the fact that it supplies wet steam to the jackets, which, as is well known, parts with its heat much more readily than dry steam, for reasons doubtless understood by our readers.

Now, it may be said that the Guzzi apparatus differs from that which we have suggested not only in details, but in principle; that, in the first place, he does not use waste heat, and that in the second he employs not heated water, but steam, in the cylinder jackets. At first sight this is apparently sound reasoning, yet if we read a little between the lines, we fancy it will be seen that the Guzzi apparatus closely resembles that which we have suggested. We have as yet no details or drawings, but it is easy to see that no conversion of the water into steam need take place. If the cylinder stands higher than the thermo-syphon, and the flow pipe goes into the top of the jacket while the return pipe comes out of the bottom of the jacket and enters the lowest coil of the thermo-syphon, then a good circulation of the highly-heated water will take place. Whether this is the mode of working or not depends on whether the jacket thermo-syphon and all, are filled up with water to begin. It seems that if this is not done, superheated steam might be produced, the very last thing wanted. Again, we have the suggestion that liquids of high boiling point might be substituted:—"Au lieu d'eau, on pourrait employer pour former la chemise de vapeur, tout autre liquide dont le point d'ébullition est très élève. Ainsi le mercure et l'huile de lin dont l'ébullition commence à 350 deg. et 316 deg. Cent., ont à 200 deg. une tension bien inférieure à l'atmosphere et leur emploi despenserait de donner à different parties de l'appareil la solidité qu'exige la resistance à la vapeur d'eau portée à une haute temperature." This passage indicates, we think, very clearly that the use of the liquid and not of its vapour is contemplated.

In writing thus we have no desire to claim that we have anticipated Signor Guzzi. Our object is to show that what we believe to be a valuable method of increasing the economy of the steam engine has already been tried with success. It does not appear to be certain that the thermo-syphon is heated by waste heat. But it is clear that no difficulty exists in raising the temperature of water in this manner. A few pipes might be arranged, as in Green's economiser, to effect the required object. If it is objected that it would be dangerous to admit hot water under a high pressure to a cylinder jacket, we reply that it is not necessary to do anything of the kind. The hot water pipe may be arranged in long coils to lie in the jacket; the jacket to be filled with oil. The oil would then be heated by the water circulating in the coil, and would in turn heat the cylinder. In all this there is no manner of complication, and the cost would be small, while the saving in fuel would no doubt be considerable. Is it too much to hope that some enterprising English firm will push Signor Guzzi's inquiry further?

ARMY TOOLS.

Lord Wolseley's letter on the bad quality of tools supplied to the army has excited renewed interest on this subject in manufacturing circles. Messrs. Spear and Jackson, of the Etna Works, Sheffield, state that early during the Crimean war similar complaints were sent home from the commanders of our troops, then before Sebastopol. Mr. Roebuck, who then represented Sheffield, urged the Government of the day to take up the matter, and at his instigation a special commission was sent into the manufacturing districts to make inquiry and report to head quarters. Sheffield was visited, and from the Etna Works samples of tools were taken to London. Messrs. Spear and Jackson state that these were not old Government samples, but patterns that were in current make for the open market. These patterns were approved and adopted by the authorities, with the result that during three years, until the Crimean war closed the firm made for the Government 60,000 bill hooks, 30,000 spades 30,000 shovels, and 30,000 picks. Messrs. Spear and Jackson state that if any of these articles are yet in store, they are prepared to risk their reputation that they are as good and serviceable as it is possible to make such goods. After the close of that war, when public indignation had moderated, "matters got again into the old groove," and the firm state that although they have since then frequently quoted for the same class of articles, and based their quotations upon the current price of labour and material, they have never been able to secure a further order. This is no doubt the first of a series of communications from various firms. The probable explanation of untrustworthy tools is no doubt the old one of price. If the Government will persist in accepting contracts at lower figures than those at which the goods can be profitably made, the inevitable result must be a breakdown. No thoroughly good weapons or implements can be supplied without a profit. Manufacturers do not manufacture from motives of patriotism, but of profit. It is surely better that the Government should pay the proper wholesale price of a respectable house than risk sending orders to others who quote low to tempt trade. The British Government, it is said, "should buy in the cheapest market." This is altogether wrong. The British Government should do as all sensible people do—they should buy in the best market the best goods they need for their purpose, for the best goods are always the cheapest in the long run.

PROFITS ON GAS PRODUCTION.

It is well known that in the case of the metropolis the gas companies pay very large dividends, and that year by year the companies have to report increasing consumption, despite rival lights, and that under the sliding scale there is the sweet simplicity of 12 per cent. dividends to the shareholders. It will be interesting to give an instance of a company close to the edge of one of the best gas coalfields in the world—to which some four years ago we referred in The Engineer—to ascertain how far the metropolitan conditions we have named still apply. The Hartlepool Gas and Water Company is one of comparative age; it should have the advantage of very cheap coal, and it has a growing constituency, and there are favourable conditions. We need not now touch upon the water supply, as the accounts show separately the results of working. In its recently concluded financial year, then, there was a carbonisation of 17,107 tons of coals, none of which was cannel. The gas produced is

not stated, but the yield of companies does not materially differ. The bulk of the gas—119,709,800 cubic feet—was sold at 2s. 6d. per 1000ft., producing £14,963 ; but there was also a revenue of £3665 from gas for public lighting and that sold under contract; but the discounts for the whole, presumably, were, in the total, £1006. The coals, with the carriage, and the placing in the works, cost about 7s. 6d. per ton, so that this was much less naturally than the cost to the metropolitan companies ; and altogether, the manufacture and distribution of gas cost £10,641, whilst management, rates, &c., raise the expenditure on the gas side of the account to £13,239. Of the coke yielded in the manufacture—10,783 tons—there were 2264 tons used, and the remainder was sold, the net price realised being about 7s. per ton —a very good price, it would seem; but the other residuals do not sell so well as they used to do a few years ago. Still, after paying the expenses of the manufacture, and of those necessary additions thereto, there remains the balance of £9074 12s. 5d. to pay interest on capital, &c. The cost of the gas works, inclusive of some manufacturing additions not yet completed, was £154,074, and as we have said that the year's profit was £9674, it will be seen that the profit on the whole capital was fair, but far less than that of the great companies at a distance from the coalfield. The moral is plain—it is that there should be a larger sale of gas, and how that is to be brought about may be a question left to those concerned. The coal is not very dear, though scarcely so cheap in proportion to distance from the coalfield as it should be ; there appears to be an ample demand at a full price for the most profitable of the residual products ; but in the plant and in the distributive plant there is a vast capacity which is unused. The further use of this plant, and especially the use in the daytime, is what gas companies have to look forward to to increase their return; and this is the case, not with one, but with all gas companies. For heat and power there would be a much greater demand for gas, if there were a sale during the day, either of a cheaper and more suitable gas, or at any rate of gas which would be less costly. This is what the companies somehow will have to bring about, and when they do that they will have a demand that will give a more equal pressure on their works and pipes, and one which will more than make up any fall that may, by the use of other illuminants, take place in gas for lighting.

LITERATURE.

Analyses of the Accounts of Gas Companies and Corporations 1886. London: John Allan, offices of the *Gas World*, Cranecourt, Fleet-street.

The publication bearing this title contains the accounts of seventeen gas companies, together with eleven corporations and one local board having gasworks. The accounts are in each case accompanied by an elaborate analysis set forth on an uniform plan. The arrangement has the advantage of giving a very complete view of what each company is doing, but it scarcely admits of ready reference for comparison. In this latter respect we rather prefer the yearly "Analysis," by Mr. Field. The ground covered by the two is somewhat similar. Out of the thirty-four undertakings analysed by Mr. Field, the present work includes half. For the seventeen omitted we have twelve others substituted, consisting of five companies, six corporations, and one local board. The companies are the Alliance and Dublin Consumers', the Dudley Gas Light, the Harrow District, the Pontefract, and the Redhill. The corporations are those of Blackburn, Carlisle, Heywood, Lancaster, Stafford, and West Bromwich, the local board being that of Tipton. The corporations included by Mr. Field, and omitted from this later publication, are Halifax, Leeds, Oldham, and Salford. The companies omitted are those of Bath, Bristol, Derby, Plymouth, Portsea, Preston, and Sheffield, in the provinces, and those of Colney Hatch, Lea Bridge, Mitcham, Richmond, Wandsworth, and West Ham, in the metropolitan suburbs. One thing which strikes us as a defect is that of giving the half-yearly accounts where such are published, instead of throwing them into a yearly form. Thus, for instance, we have to compare the accounts of the Chartered Company for two half-years with the Liverpool accounts for a year. The analysis is in every case very complete, but a more compact system seems desirable, and certain supplementary particulars given by Mr. Field are not included in the plan of the work. At the same time, the book will be useful, though we think it might be improved. It will not be easy to surpass Mr. Field, though it may be well that the attempt should be made.

Notes and Formulæ for Mining Students. By J. H. Merivale, M.A. 8vo., pp. 137. London: Crosby Lockwood and Co. 1887.

This is a collection of notes and formulæ drawn from various sources, the authority being given in most instances, which was originally compiled by the author for the use of his students at the Durham College of Science, in Newcastle-upon-Tyne, and is now issued in a revised and somewhat enlarged form for the use of the mining world in general. The scope of such a book must necessarily be limited, neither can there be much opportunity for originality in treatment when the essentials of mechanical and physical knowledge in their numerical aspects have to be presented in a few pages; but within these limits the author has done his work in an exceedingly creditable manner, and has produced a book that is likely to be of service not only to students, but also to those who are practically engaged in mining operations. In form the work is essentially a syllabus of a course of mining teaching, the subjects of machinery, search for minerals, sinking, systems of working, winding, pumping, and hauling being noticed in regular order, after which some considerable space is devoted to the physics and chemistry of gases, and their application to the subject of ventilation. A final chapter contains examples of the application of many of the different formulæ to the solution of problems arising in practice which are very well chosen. As might be expected from the author's position, coal mining, especially as it is practised in the Northumberland and Durham coalfields, receives the largest share of attention, the notices of mineral mining and very few and insufficient. The description of vein mining by the terms in use in collieries is not a commendable practice. The table of the weights of metallic minerals per square fathom 1in. thick should also be accompanied by a qualification that such masses are not, as a rule, found in nature.

BOOKS RECEIVED.

A Handbook of Electrical Testing. By H. R. Kempe. Fourth edition. London: E. and F. N. Spon. 1887.

The Professor in the Machine Shop. Part I. Reprinted from the *Mechanical Engineer* (American). New York: E. P. Watson and Son. 1886.

University College, Dundee: Calendar for Fifth Session, 1887-88. Dundee: John Leng and Co. 1887.

Minutes of Proceedings of the Engineering Association of New South Wales. Vol. i. Edited by Gustave Fischer. Sydney: The Association. 1886.

Practical Hints on House Drainage for House Owners and others. By a Clerk of Works. London: Scientific Publishing Company. 1887.

The Journal of the Iron and Steel Institute, 1887. No. 1. London: E. and F. N. Spon.

Annual Statistical Report of the Secretary to the Members of the British Iron Trade Association on the Home and Foreign Iron and Steel Industries, 1886. London: E. and F. N. Spon. 1887.

The Indispensable Bicyclists' Handbook. By Henry Sturmey. London: Iliffe and Son. 1887.

The Gas and Water Companies' Directory. 1887. Edited by C. W. Hastings. — *Waterworks Statistics*, 1887. Edited by C. W. Hastings. — *Gasworks Statistics*, 1887. Edited by C. W. Hastings. London: The Scientific Publishing Company.

Ninth Annual Report of the Transactions of the National Association of British and Irish Millers. London: J. H. Chatterton.

Exercises in Quantitative Chemical Analyses; with a Short Treatise on Gas Analysis. By W. Dittmar, LL.D., F.R.S. Glasgow: W. Hodge and Co. 1887.

INTERNATIONAL RAILWAY CONGRESS, MILAN.

Refreshed by their *gita*, or trip, to Genoa "la superba," the members of the International Railway Congress set to work in the sections with redoubled ardour on Friday, September 23rd, and in the afternoon the third general meeting was held in the Scala, under the presidency of Senator Brioschi.

M. Banderali, of the French Northern Railway, brought up the report of Section 2—Stock—as to Question 10, "What is the best lubricant and the best form of axle-box for locomotives?" The conclusions of the section were unanimously adopted, viz., that a mixture of vegetable and mineral oil, with due consideration for climatic influences, and white metal for axle bearings, are to be recommended.

As to the lighting and heating of trains—Question 13—on the report of M. Dery, of the Belgian State Railway, Section 2 came to the conclusion that enriched gas was preferable to naphthaline, and that the difficulties in the way of electrically lighting trains was still very great, so that this portion of the subject had better stand over to the next Congress. Incidentally, M. Picard, of the P.L.M. Company, remarked that putting the shade for darkening the carriage in connection with the gas stop-cock saved his company 100,000f., or £4000, a year. As to heating, it was decided that the question had not been satisfactorily solved, but that movable foot-warmers had hitherto given the best results.

As to the best system of premiums—Question 11—Section 2 referred to the report of M. E. Solacroup, assistant chief engineer to the Orleans Company, detailing the practice of the English, the leading French, and other companies, and voted for fixed and sufficiently remunerative wages, with premiums for economy, provided they do not interfere with safety and regularity.

Signor Peruzzi brought up the report of the fourth section—general matters—as to Question 20, "The Organisation and Recruiting of *personnel*, and the Employment of Women," recommending the formation of special schools for training railway servants, who should be taken as far as possible from the families of those already so employed. He warmly espoused the cause of the weaker sex, paying a high tribute to the steadiness and sense of duty evinced by women employed in railway work, while what was at present against them, a deficiency in physical power, was met by the hydraulic arrangement for working points and signals that was being tried by the Mediterranean Company, and which the members had had an opportunity of witnessing.

As to remuneration—Question 21—the same section recommended that higher wages be paid to the lower grades of railway servants, with a simplification of their work or service, and the adoption of mechanical means for lightening their labour. Incidentally, the establishment of co-operative associations for the supply of provisions, &c., was warmly advocated, and Signor Luzzati gave some interesting information concerning that established at Milan, which the members were invited to visit.

The meeting was strongly opposed to any attempt to enforce uniformity of gauge or stock on secondary lines—Question 31—as these were laid down for purely local purposes, and must be arranged to meet the wants of each special locality, while any movement for combining them into a system would inevitably be regarded by railway administrations as evidence of competition, which was most undesirable.

The question of maintenance of permanent way, was introduced by Herr Lommel, director of the Jura-Berne-Lucerne Railway, and "reporter" of the first section—Way. The idea of letting by contract the maintenance of way was unanimously rejected. It was considered that there was too great supervision of level crossings, and that fences often favoured instead of averting accidents.

It was then decided that, for the first time exceptionally, the whole instead of half the Permanent Commission be renewed, the present members, however, being eligible for re-election. A few modifications were also introduced into the rules affecting future international congresses, the principal being that Article 2 now reads as follows:—"The association consists of the adhering Governments and Administrations which work or have conceded to them railways of public utility." Amid much enthusiasm, Paris was selected as the *local* for the third Congress in 1889, M. Léon Say promising a hearty welcome.

In the evening presidents, vice-presidents, and secretaries dined at the Monza Palace with King Humbert, a most constitutional monarch in the van of all progress, moral and material, and universally beloved by his subjects. A large number of members availed themselves of a special train, put at their disposal by the Mediterranean Company, to witness the subdivision and recomposition of goods trains at the Smestamento or Porta Sempione Station by aid of the electric light. Six trains from different parts were re-made up for various destinations in three quarters of an hour, the signals for moving the points for the different sidings being given by bugle as each wagon was detached. The train was composed of some new carriages designed by Cav. Ing. S. Fadda, Chief of Division on the Mediterranean Railway, which combine the advantages of the transverse and longitudinal systems, while avoiding their defects.

On Saturday, 24th September, Signor Brioschi again presiding, Signor Peruzzi brought up the report of the Fourth Section—matters of general interest—Question 24 of which—as to the development of international relations between railway administrations—having formed the subject of a voluminous report by Signor Fadda, secretary of the section, was referred to the Permanent International Commission. As to Question 24—provident institutions—it had been stated in the section that the Orleans Company granted for this purpose 10 per cent. of its profits, while also making a deduction from the men's wages to add to the fund. A resolution that the statistics on the subject be collected was approved, and the question was relegated to next Congress.

M. Banderali read the report of the Second Section—Stock—on Question 7, the running of engines and drivers with a view to better utilisation of engines, and a more even distribution of work among drivers. The section recommended that a gang of drivers be attached to a set of engines, and not that each driver have his own engine, with a view of getting all the work possible out of an engine in a given period, thus saving, as remarked M Griollet, vice-president of the administration of the French Northern Railway, a great deal of current expense, and preventing the accumulation of useless, antiquated engines. This was endorsed by the meeting, which then proceeded to discuss Question 12—What conclusions may be drawn, both from an economical and a technical point of view, from the latest results obtained by the use of continuous brakes, automatic or otherwise, in goods or passenger trains. It was agreed that the use of continuous brakes was impossible on international goods trains on account of the great dissimilarity of the rolling stock in different countries, while for passenger trains an improvement in the connections was recommended. With respect to locomotives—Question 9—the same section adjourned the discussion of the compound principle to next congress, condemned steel proper for boilers, but recommended a cast, homogeneous metal for that purpose, and copper for fire-boxes, all which was endorsed.

The first section—Way—then had another innings, Herr Lommel informing the meeting, as to Question 5—precautions against snow—that in Switzerland snow is used to make embankments for resisting avalanches. The section, however, had decided that snow was a quantity so variable in the different countries, that it was useless to lay down any general rules on the subject. As to Question 6—"What influence do the conditions of laying down lines of heavy traffic exert on the expense of maintenance both of way and of stock?"—no definite conclusion was arrived at; but the section recommended the use of good ballast, frequently renewed, of sleepers larger than those hitherto employed, and of strong fish-plates, with constant and minute inspection.

M. Albert Jaquemin, general superintendent of the Eastern of France Railway, brought up the report of Section 3—Working—as to the 15th question—"What are the most favourable conditions for organising passenger trains on main lines?"—and the 18th—"The shunting and marshalling of trains with a view to safety and economy." While the report gave a considerable amount of information on those two subjects, further particulars were invited, and the conclusions were deferred till next Congress.

The questions specially affecting secondary railways were then brought forward by the president of the 5th Section, M. de Burler, director-general of the National Society of Vicinal Railways in Belgium. He regarded transhipment as the great disadvantage of secondary railways. For the transference of passengers, however, it was sufficient to arrange the platform of the secondary line as near as possible to that of the main railway, and for the transshipment of goods the secondary line of way should be brought so near to the main line that the wagons almost touch each other. In Switzerland the small-gauge lines were regarded in the light of carriers bringing goods to the main railway, while in France favours were granted to small lines which bring an accession of traffic to the large. The section expressed a hope that secondary lines be regarded as the allies and not competitors of railways, and invited further information.

The programme of the second Congress being now exhausted, all the members of the permanent commission were re-elected, viz., M. Fassiaux, Belgian Government, president; MM. Almgren, Sweden State Railway; Ambrozovics, Hungarian Government; Belpaire, Belgian State Railway; Berger, Belgian Government; Borgnini, Adriatic; Brame, French Government; Brioschi, Italian Government; De Bruryn, Belgian Vicinal; Dubois, Belgian State; Tony Dutreux, Luxemburg Government; Sir Andrew Fairbairn, Great Northern; Griolet, Northern of France; Lamal, Belgian Government; M. Massa, Mediterranean; Peruzzi, Italian Government; Rholippe, North Belgium Baron Prisse, Antwerp and Ghent; Com.

Ratti, Mediterranean; Thielen, German Government; Urban, Grand Central Belge; Van Kerkwijik, Dutch Government; Von Leber, Austrian Government; Werchovsky, Russian Government, with M. Aug. De Laveleye, Secretary-General; M. E. Kesteloot, Secretary, and MM. Holemans and Weissenbruch, Assistant Secretaries. To these were now added to make up the statutory number, MM. Pinheiro, Brazilian Government; Jeitteles, North Emperor Ferdinand; Perk, Russian Government; and Dittles, St. Gothard Railway.

Several complimentary speeches were then made; and the Congress was formally closed by the president. In the evening a grand banquet was given to the members by the Italian Government in the public gardens of Milan. In the course of the day several members had availed themselves of an invitation to visit the co-operative stores in connection with the Mediterranean Railway administration at the Palazzo Litta, which has a remarkably handsome marble staircase. Great interest was manifested in a machine for cutting *mortadelle* and Bologna sausages into thin slices expeditiously. The sausage is fixed down to a travelling bed, which is fed up to a revolving disc provided with knives like a chaff cutter, the travel being given automatically and the machine worked by hand. A great many fungi of all shapes and colours, differing widely from our mushroom, the *agaricus campestris* were exposed for sale to the members of the Co-operative Society.

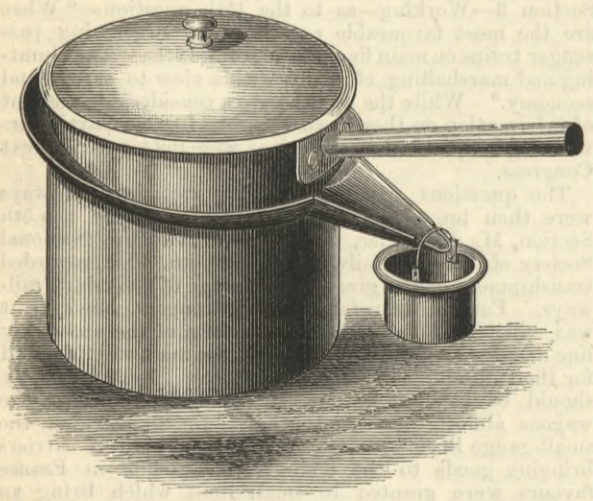
On the following day proceedings were wound up by—to use the official language—the Bouquet of the Congress, in the excursion to Lake Como, under a cloudless sky and with the most pleasurable accompaniments. A special train took the visitors to Lecco, where a buffet was provided; a saloon steamer then took them on to Belaggio, when they were divided into three parties to partake of a banquet, modestly called lunch, by invitation of the Mediterranean, Adriatic, and Como Navigation Companies; then, re-embarking, the united party steamed round the lake, disembarked at Como, and finally returned to hospitable Milan by nightfall.

Having, in connection with this Congress, passed a considerable space of time on the railway, we would strongly urge a practical solution of one of the questions submitted to the Congress and adjourned to the next, viz., the double suspension of carriages and interposition of an elastic medium between the body and the underframe. When passengers are shut up for several hours together, they should find it practicable to write as well as read, while all the material requirements of frail humanity should be provided for, as they are in the through family carriages of the enterprising Midland Company. Moreover, we would like to set a question for the consideration of the next Congress, if not thought too minor a detail, viz., the getting out of a self-acting carriage handle cleaner. Not only is the presence of a thick coat of finely-divided carbon on the brasswork of carriages quite subversive of that virtue which is next to Godliness, but the presence of this "matter in the wrong place" also proves incomplete combustion of the *briquettes* in the fire-box of the engine, and consequently a derogation from economical working. Of course, at stoppages a man comes with a bit of waste to wipe down the carriage handles; but he cannot do more than one at a time, and before he has got half through, the passengers, impatient to stretch their legs after a long imprisonment, have often saved him the trouble.

In conclusion, we desire to tender our best thanks to Signor Ingeniere Lampugnani, the enlightened and energetic general secretary of the Mediterranean Railway Company, for help of all kinds, and especially, on one occasion, for disentangling for us a vast maze of red tape.

DOMESTIC COOKING APPARATUS.

In the article in our impression of the 12th of August last, on the above subject, reference was made to the cracking of the hot plates, bars, and grids of gas stoves when liquids left to boil



boiled over. To prevent this frequent source of breakage of gas stove parts Mr. J. Lehman, of Tower-buildings, Liverpool, has devised the encircling channel and spout illustrated above as applied to a saucepan. Any liquid that boils over is caught in this channel and conveyed over the side of the stove, or into a receptacle hung on the spout as shown. The invention has, it is thought, applications in chemical works and breweries.

South Kensington Museum.—Visitors during the week ending October 8th, 1887:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m.: Museum, 8232; mercantile marine, Indian section, and other collections, 3779. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 5 p.m.: Museum, 991; mercantile marine, Indian section, and other collections, free, 2965. Total, 15,967. Average of corresponding week in former years, 17,482. Total from the opening of the Museum, 25,941,367.

EXPLODED PORTABLE ENGINE, MELTON CONSTABLE, NORFOLK.

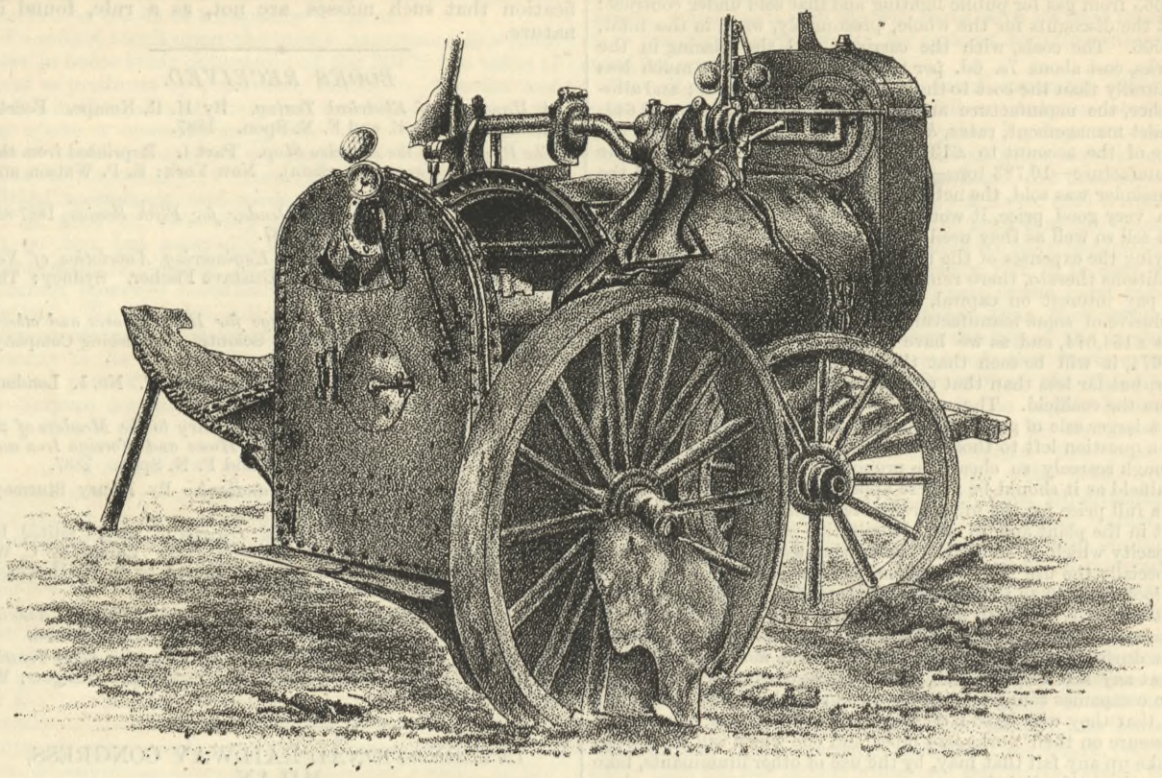


Fig. 1.—RIGHT SIDE VIEW OF THE ENGINE AFTER THE EXPLOSION.

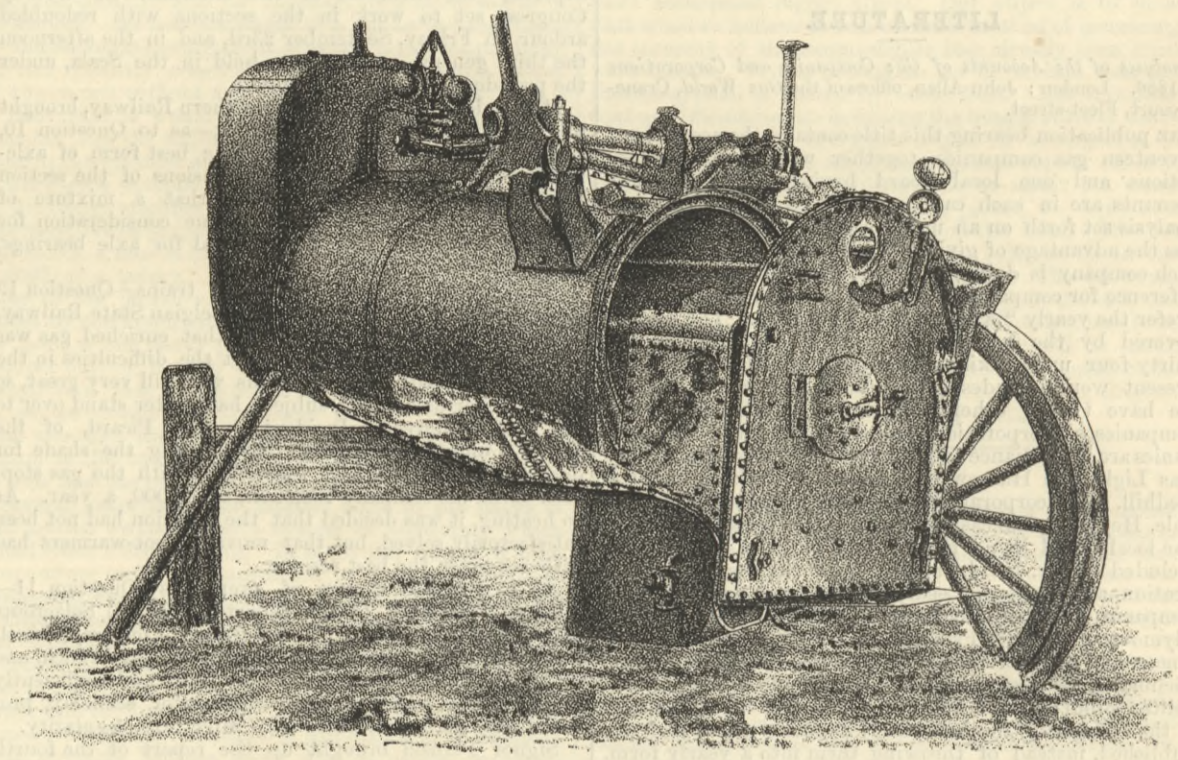


Fig. 2.—LEFT SIDE VIEW OF THE ENGINE AFTER THE EXPLOSION.

EXPLOSION OF A PORTABLE ENGINE.

The accompanying engravings illustrate the condition of a portable engine after explosion. The explosion occurred about 1.45 p.m. on the 28th of April, at Melton Constable, Norfolk. The driver was severely scalded and burned. He was blown thirteen yards away. The engine was made by Messrs. Clayton and Shuttleworth in 1855. The length over all is 9ft. 4½in. The length of the barrel, exclusive of the smoke-box and fire-box, is about 5ft. 11in., and its diameter internally 2ft. 6½in. The barrel is made of two $\frac{5}{16}$in. plates, with a longitudinal joint at the top and bottom, and it is joined to the tube-plate at the smoke-box end, and to the outer shell of the fire-box, by external angle-iron rings. The shell of the fire-box is about 2ft. 1½in. long by 3ft. broad. Its sides and crown are $\frac{5}{16}$in. thick, and are said to have been originally formed of one plate; but the plate was cut some time ago at each side, at about 2ft. 5½in. from the bottom, and new side-plates were attached to the original crown by single rivetted single butt strap joints. The end plates of the fire-box are $\frac{3}{8}$in. thick, the front end was originally formed of one plate, but it was cut at the same time as the side plates, the new lower plate being joined to the original upper plate by a single-rivetted, single-butt strap joint similar to the joints in the side plates. The fire-box is about 2ft. 8½in. high, 2ft. 7⅛in. wide, and 1ft. 6¾in. long, and appears to have been made of $\frac{3}{8}$in. plate. The sides and ends are supported by $\frac{7}{8}$in. stays, screwed into each plate, and having their ends rivetted over. The top is supported by three cast iron girders, each girder being fitted with two supporting bolts. The girders are 14¾in. long and 2⅝in. deep, by $\frac{15}{16}$in. thick at the centre. All the seams are of the lap and single-rivetted description, except those mentioned above; the rivets being about $\frac{3}{4}$in. in diameter, and spaced 2in. apart. There are 23 ordinary tubes, 6ft. 3in. in length and 2½in. in diameter, internally fitted with ferrules at the fire-box end. The end plates in the steam space are supported by two longitudinal stays, $\frac{3}{4}$in. in diameter at the smallest part.

The boiler was not insured nor inspected by any of the inspecting companies. Mr. Chipperfield, the owner, said that he inspected it from time to time whenever he thought it necessary to do so. In March this year he thoroughly inspected it, and tested it by cold water pressure to 140 lb. per square inch, and he was satisfied by the test that it was fit to carry 80 lb. per square inch. The crown plate of the outer shell of the fire-box parted at the ends of the manhole. The fractures then continued along the edges of the plate as shown by the sketches. Portions of the plate were broken from the main piece, and have not yet been found. The safety-valve chest was hurled 125 yards from the scene of the explosion. The manhole door was also missing, and although a diligent search was made for it, it had not been seen since the explosion. The explosion was due to the rupture of the fire-box shell crown plate in consequence of the boiler being subjected to excessive internal steam pressure. According to the evidence, there was within the boiler on the day of the explosion nearly three times the pressure per square inch it was said to have been designed to carry when new, over 31 years ago, and for such a pressure it was wholly unfit. This high pressure appears to have been allowed to accumulate in consequence of the driver misunderstanding the indications of the steam gauge. The safety-valve, which was said to have been adjusted to blow automatically at 60 lb. per square inch, as shown by the steam gauge, did not, according to the evidence, blow freely at more than twice that pressure. Whether the valve was intentionally fastened down by some person, or was jammed in its seat, could not be ascertained. The spring-balance had not been found since the explosion, and the safety-valve had been carried off by someone before the inspection. But it is evident that the valve did not act at the pressure at which the owner said he had adjusted it to blow.

The People's Palace.—An apprentices' exhibition of art, industry, and invention will be held at the People's Palace for East London in December next. The object of the exhibition is to encourage the old apprenticeship system, which is generally admitted, to the detriment of English industry, to be gradually dying out. All boys and girls who are serving their time as bound apprentices within the metropolitan area will be qualified to exhibit. The committee will be prepared to receive exhibits from, and to consider any special cases of boys or girls who, though not legally indentured, are *bonâ fide* serving an employer for a fixed term of years for the purpose of learning a trade. The exhibit must be the genuine handiwork of the exhibitor. The trustees have given a large sum of money to be awarded in prizes. Silver and bronze medals and diplomas will be granted to the most meritorious exhibits, special instruction being given to the judges in making their awards to have regard to the number of years each exhibitor has served at his trade, so as to encourage apprentices even of twelve months or two years, as well as those who are nearer the completion of their time.

THE ELEVATED RAILROADS OF NEW YORK.

Here, as on all roads, the locomotive is the central figure; practical men and poets alike look first at the feature which appears to have the most life and activity in it; and the department which includes this is always of interest. A full account of its workings would be well worth the reader's attention, but would extend beyond the scope of this article. As in other things already alluded to, the methods are not so different from those of other roads except in their application; and that can be appreciated only by a close study. Faithfulness in any field has a value that often can be computed in black and white only by careful study of the final results; and on this road faithfulness is, *par excellence*, the vital point. The weight of the engines being limited by the strength of the structure they travel upon, faults must always be corrected by some way other than the enlargement of parts; and the reputation of the road depending upon the acme of promptness in handling the traffic, delays must be guarded against with the utmost vigilance. It follows, therefore, that the inspection of every detail of the rolling stock must be of the most thorough kind. Important parts being light, must be renewed before they show the least sign of weakness; oiling must be done with strict precision, a careful record being kept, in a book, of every car. Locomotive boilers are examined and washed every month, and a special examiner inspects the trucks of the engines at the same interval.

The success with which the inspection of engines is carried out is shown in the severe service performed, a dozen or more engines being kept running twenty-four hours each per day—with three crews—for a month at a time. The number of men in the shops is not so large as it will be, and the proportion of engines in service is larger than can be maintained permanently, for few or none of them have as yet reached the age where they require such important repairs as renewal of the fire-box. At present there are about 240 engines in service, with an average of only fifteen in the shops. There are 900 cars.

The non-automatic Eames vacuum brake is used, and gives very little trouble. At first thought the absence of automaticity would seem to be a serious defect in a brake used on trains carrying such an enormous number of passengers, but there are special circumstances in favour of the vacuum. The maximum speed is not high, so that the danger from a failure is not so great as in ordinary train running, and the guards—which, by the way, seems a very appropriate title for men in this position, who do virtually no braking whatever—being obliged by their ordinary duties to be always very close to the brakes, are likely, in case of necessity, to get old of them in the minimum time. The cars being light, it is of course desirable to relieve them of shocks as much as possible, and the use of a plain non-automatic brake which can be easily graduated is found to practically eliminate shocks. The trains being short the action of the brake is very quick, and it is applied to every wheel in the train at the same instant. This simultaneous action in practice is found to relieve the cars almost wholly of compressive strains, the buffers showing hardly any signs of ever having touched each other.

A non-automatic brake is less liable to cause delay by failures to release and by sudden and unexpected application by the hose blowing off. The slightest delay is of considerable importance on such a crowded line as the Manhattan, and these considerations are strongly in favour of a non-automatic brake of the simplest and most durable construction.

The locomotive runners, although paid for nine hours a day, work on an average only about 8¼, but the constant service exacted from the engines makes some inconvenience for the men, because it frequently happens that on the arrival of the hour at which a runner is off duty he will be five or ten miles from home, and must spend from fifteen to twenty minutes in reaching his headquarters after he gets off the engine, while the man who relieves him has spent an equal time in getting to the appointed place of change. The men eat one meal while on duty—except those who have divided days, part morning and part afternoon, with a rest in the middle of the day, when traffic is lightest—but there is generally a rest of ten to twenty minutes at a terminal, so that they do not have to eat while running.

The "extra" enginemen shown in the list are paid for all days on which they report for duty whether there be any work for them or not, though in the other departments applicants are plenty enough, so that the required force is maintained without paying wages except for actual trips performed. The continuous service of the engines as well as of cars is largely necessitated by the lack of terminal facilities. Trains finishing a trip must be immediately started on another, because there is no track room for another train if it were available; so that the vigilance required to keep cars and engines in the very best condition is required, not by lack of rolling stock, but lack of room to keep it in. A surplus stock of cars or engines to take the place of disabled ones—and thus render prompt repairs less imperative—would do more harm than good, for they would occupy valuable space.

The enginemen on the Elevated, as well as other *employés*, learn by observation, as has been already noted, to an extent seldom seen elsewhere, and thus constantly advance their knowledge of their art, while the excellent system of discipline at the same time checks all extravagant notions or habits resulting from unbalanced judgment. The result has been to form a body of men whose qualifications are more uniform than generally is even hoped for. With most officers a code of rules seems like an impracticable ideal which a body of men can never be made to conform to; it is complained that individuals differ so greatly in their natural and acquired characteristics that with the very best of training they will always differ widely in their ways of doing things. And this is largely true; but success on the Elevated is not attained by employing men who have no judgment, and who thus have to work by rule or not at all; neither is the process such as to destroy or drive out individual talent; for training, pure and simple, never hinders growth, but simply directs it.

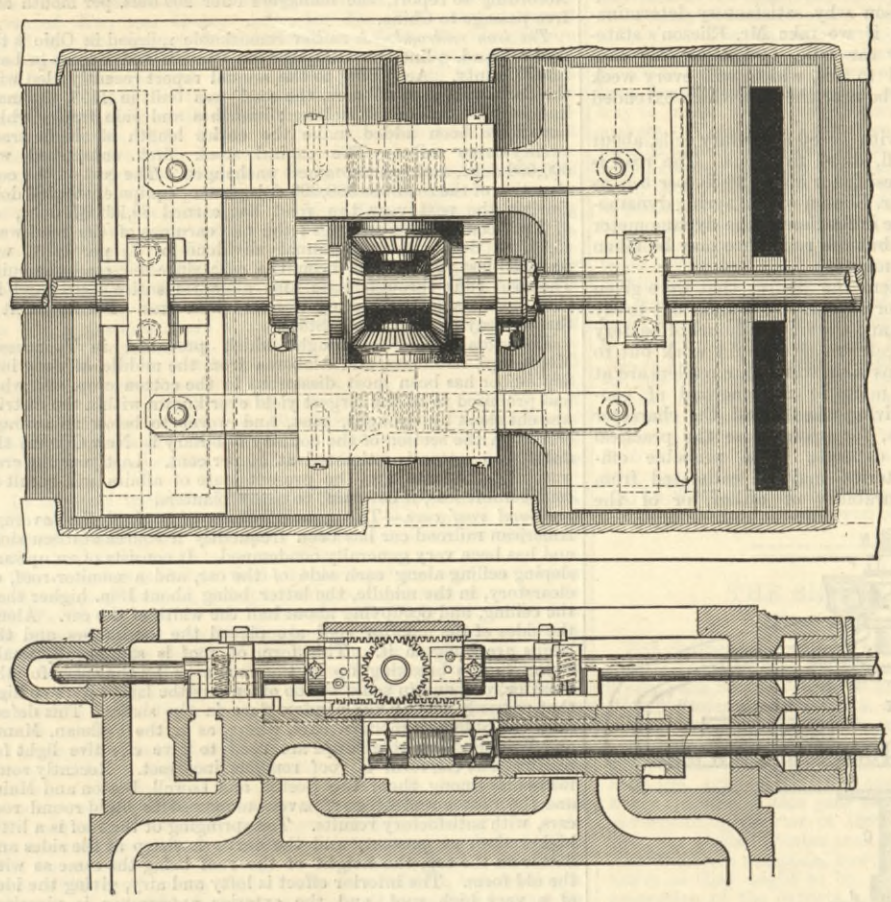
The Elevated officers have the well-known advantages always possessed by those who work on a large scale in any activity. The dry goods store, the machine shop, or the printing office that does the largest business is naturally the place to find the best methods and most economical and successful operation; and in training men, engine-runners or others, the same rule holds. Smaller roads cannot adopt all the desirable plans in use here, but they can imitate them, and learn much that is applicable in different circumstances, and that is the reason we advise them to investigate the methods used here.

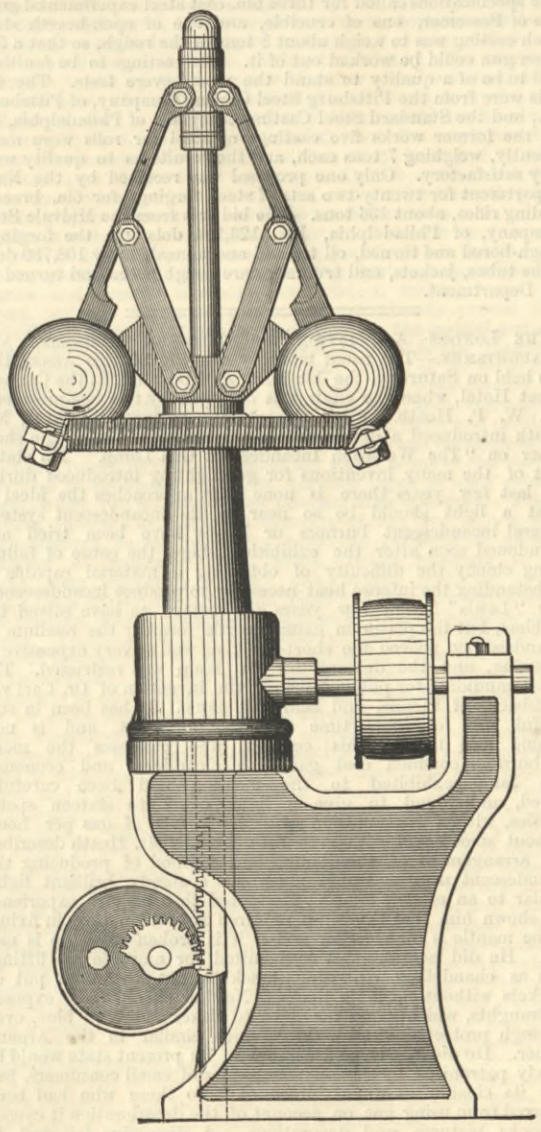
The road foremen are occupied chiefly in the instruction of the men on the engines in economical methods of firing, and there being only two for the whole road, they have enough to do. Other duties which would in ordinary practice devolve on these officers are performed by the train dispatchers. With such a large number of trips so compactly arranged, and being under the necessity of always making each man's day figure out less than nine hours, while still making use of a minimum number of extra men, these dispatchers find a large portion of their duty to consist in assigning the men their runs and recording the particulars concerning each trip. The dispatcher is the important medium between the runners and the management, and he has constantly on hand some one of the thousand occurrences such as can never be attended to by mere routine. He has to formulate all complaints, both of and from the engineers and firemen, and has to decide as to the relative importance of many of them, and whether or not they shall be settled on the spot or referred to a higher officer. The trips being so short, and the men so easily get-at-able, he can use his time to much better advantage than on an ordinary road. With men away from headquarters six to thirty-six hours each trip, and most of them necessarily irregular, it would be impossible to supervise them so efficiently. Superintendents and master mechanics who would emulate the Elevated can see therefore that they would quite likely need two, four, or six times as many officers of this kind as suffice here. For the reasons just named, the road foreman would have more, and the engine dispatcher less, to do with the inspection of the actual practices of the runners than is the case here. Numerous things besides fuel economy demand the attention of the officer who is intimate with the men when they are out on the road.—*Railroad Gazette.*

HORTON'S PATENT AUTOMATIC CUT-OFF VALVE AND GOVERNOR.

No type of cut-off valve has given better results than a simple slide valve riding on the back of the main slide valve. The chief reasons are that the clearances are reduced to the lowest possible terms, the ports being so short that it is almost equivalent to cutting off by the main valve.

Our engravings show a new design of this type of automatic cut-off which has just been introduced. It secures uniform lead, release, and exhaust closure at all points of the stroke. The main valve is operated positively and directly by one excentric. The cut-off is effected by valves riding on the back of the main valve, which are operated positively by a separate excentric. The point of cut-off is automatically varied by the partial rotation of the valve spindle, effected by means of the governor, which gives motion to the segmental gear upon the cut-off valve spindle. In the engravings shown, which are taken from an engine in actual use, the adjustment of the cut-off, from zero to two-thirds stroke, is effected by a vertical movement of the governor spindle of only 1in., but even this can be reduced by changing the relative sizes of the gears.





The segmental gear is wide enough on the face to cover the throw of the excentric, plus the full width of the rack on the governor spindle. This rack and segmental gear are of hardened steel, and have broad bearing surfaces, so that six months' use, at 90 lb. pressure shows no perceptible wear. The design of this cut-off is such that the labour performed by the governor in actuating the cut-off valves is not affected by the unbalanced condition of the main valve when the exhaust is open to the atmosphere, and the only unbalanced force which affects the work performed by the governor is the difference between the pressure in the steam chest and the diminishing pressure in the cylinder during expansion. This ceases when the main valve closes the steam port, which operates, so that, practically speaking, the cut-off valves are balanced. In actual practice on a 12in. by 24in. cylinder, the slight variation of load on the cut-off valves is not sufficient to interfere with the sensitiveness of the governor. The governor runs at high speed, and is consequently much more effective in securing uniformity than any fly-wheel governor travelling at the same speed as the engine.

An automatic stop motion—not shown—has been added to the governor since our engravings were made, which entirely closes the valves in case of breakage of the governor belt. The controlling force of this governor is not that of gravity through the rise and fall of the balls, as in the old style of pendulum governors. They do not lift from a horizontal plane, but recede or approach the governor spindle in a direct line. This is effected by the proportions of the arms and the method by which the governor is driven; it secures a positiveness of motion and directness of action which transfers the slightest change in speed directly to the cut-off valve without lost motion.—*Mechanical Engineer.*

MAGNESIA A SUBSTITUTE FOR PLASTER OF PARIS.[1]

The author, Dr. Frank, of Charlottenburg, refers to the previous experiments of Vicat, Macleod, and Deville, who had noticed the possibility of employing magnesia as a cement, but it was not until the need of finding some use for the enormous quantities of refuse magnesia salts, arising as bye-products in the manufacture of potash at Stassfurt, that the subject again recently attracted attention. The question is of all the more importance in that the other compounds, the chlorides combined with the magnesia at Stassfurt, are valuable for the production of bleaching powder and hydrochloric acid. When Sorel pointed out, in 1867, that a cement could be produced by mixing chloride of magnesium and magnesia, it was hoped that good results would ensue. The composition of this cement was based upon much the same principles as the white stopping used by dentists, made of zinc oxide and chloride of zinc. This cement of Sorel, in spite of many attempts to use it, proved a failure in consequence of a tendency, often noticed also in calcareous cements, to swell and blow, owing to deferred hydration. Dr. Grundmann, of Hirschberg, has recently patented a new method of treating the magnesia, for whereas formerly the material was merely calcined and made up with water, he now carefully slakes the calcined magnesia, and subsequently exposes the compound or casting to the action of carbonic acid gas, much in the same way that builders have been in the habit of drying and hardening plastered rooms by confining the air and burning coke in them, so as to liberate carbonic acid gas. The natural carbonate of magnesia, known as magnesite, is a mineral of great hardness and density, and the similar substance obtained by the above treatment resembles magnesite in its hardness and in its capacity for taking a good polish. Grundmann also employs the magnesia as a cementing agent for various materials, for instance, by the use of marble dust an artificial dolomite is obtained. The magnesia can also be improved by adding to it soluble silicates of the nature of water-glass, and it can be used as a stucco for building purposes.

Manchester Fire Brigade.—Another steam fire engine—Messrs. Merryweather and Sons' Greenwich pattern—is about to be added to the plant of the Manchester fire department. This is the third engine of this type.

A New Compass.—The *Alta California* gives an account of the test of a new compass invented by Leon Sirieix, a Frenchman by birth, and a graduate of the French Polytechnic. The compass as exhibited consists of a brass cylinder divided into two compartments. The lower compartment contains the corrector of the needle, while the upper division contains the compass card, which is swung on a pivot, as in the ordinary compass. On one side of the cylinder, close to the base, is a screw, and in the centre of the base is another. These are the adjusting screws, the first, A, being used for correcting the permanent magnetism, and the other, B, for the correction of the induced magnetism. The inventor placed his compass on an imaginary ship, and laid her head due north, or in other words, made the "lubber line" form one with the pole on the wall. The needle then pointed due north. On the other courses the same result was attained; the needle never deviated one degree from the north. Iron was placed around the compass, and the needle was observed to deviate a degree west. The inventor moved screw B, and adjusted the needle carefully. The imaginary vessel was swung again, and on every course the needle pointed due north. It was also shown that the compass had no "heeling error," which is caused by the rolling of the vessel. A most severe test was applied, but the card remained perfectly horizontal. The Sirieix compass was revolved at a great rate, much more than could ever be attained in swinging a ship, and directly the motion was stopped the compass card was seen to be still pointing north, and it had moved little more than half a degree on each side of the "lubber line." The compass card was spun round at a great rate. Left to itself it became dead in about one minute's time. An ordinary compass would revolve probably five minutes or more. Mr. Sirieix has in his compass avoided the use of compensating magnets placed in the deck or binnacle, vertical bars, and other arrangements necessary to the compasses mentioned. He has, to use his own expression, "centralised and neutralised" the magnetism of the ship in a spot directly beneath the compass card, thus succeeding where others have failed. The *Alta* says: "Prof. Sladky, of the University of California, has testified in writing to the splendid performance of Mr. Sirieix's instrument, and it has also been examined by Lieutenants J. B. Milton, E. J. Dorn, and G. M. Stoney, of the U.S. Navy, all of whom agree as to the efficiency of the compass."

[1] "Proceedings" of the Institution of Civil Engineers.

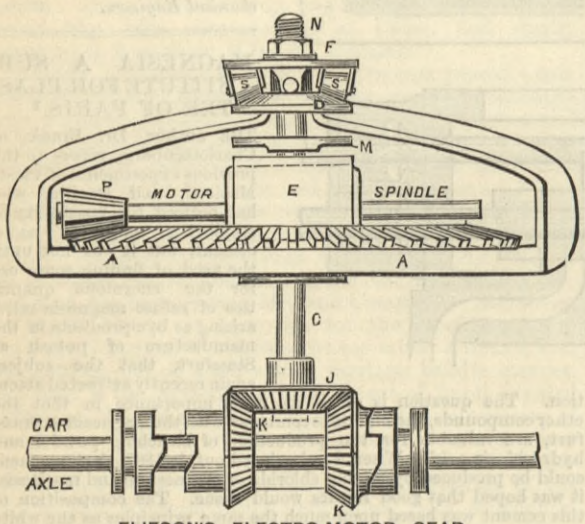
THE ELIESON ELECTRO-MOTIVE AND ELECTRIC LAUNCH.

On Wednesday, at the invitation of the Earl of Galloway and the directors of the Elieson Electric Company, a large party visited Stratford to inspect the working of the Elieson electro-motives at work hauling tram cars from Stratford Church to Leytonstone, and afterwards visited the Albert Docks to inspect the working of the electro-motor and gear driving the screw of the launch named the Countess.

The tramway electro-motives have now been running in daily work for some months, and with results that show that there is no doubt whatever that tramway lines can be worked by electro-motives. Some figures, too, of the cost of the system as compared with the cost of horse haulage, have now been obtained which satisfy those concerned that it is much in favour of the electro-motive. Part of the figures are necessarily estimated, but there is no reason why satisfactory determinations should not be made, and if we take Mr. Elieson's statement of the cost as 4·5d. per car mile, and allow for contingencies which at present add to this, which will every week become less, we shall no doubt be near the cost which extended experience will prove to obtain.

The electro-motive weighs, with its 80 secondary cells, about six tons, and the car, when full, about five tons. The road is practically level, and the car resistance about 26 lb. per ton, as near as could be measured by Mr. Elieson with a spring dynamometer between draw hooks. The indication of the dynamometer was, however, difficult to read, but the resistance may be taken as over rather than under this amount.

It is unnecessary to repeat here the figures that were given the visitors as to the accumulator charge. It is sufficient to say that, taking the speed of the car and the ampère-hours of battery charge, the efficiency of the electro-motive would work out to about 70 per cent. The questions upon which our readers are at present most interested refer more to the method of connection of the motor to the driving-wheels, and the character of the secondary battery plates, for upon these the practical success of the electro-motive depends. The probable efficiency of the motor and batteries may be estimated from well-known data, but the durability of either, or of the



ELIESON'S ELECTRO-MOTOR GEAR.

gearing, is more a question upon which each reader prefers to draw his own conclusions. The motor gives motion to the car wheels by gearing, which can be understood from the accompanying sketch. The motor is mounted within a large frame, the lower part of which is a bevel wheel A, and it is suspended upon a vertical spindle B, which carries at the upper end a plate F with conical rollers S running upon a bevel disc D and supporting the weight of the motor. The motor spindle at one end is fitted with a pinion P. When the motor rotates it causes the pinion to run round the wheel A, and the whole motor field, magnets and all, have a rotating motion upon the spindle B. This turns the bevel wheel J, which drives the wheels K, one of which is put into gear by means of clutches. The vertical adjustment of the motor is effected by the nut at N. A plate between M the field magnets E and the disc D provides an annular contact path, by means of which current is conveyed to the motor.

An exactly similar motor is employed in the Countess, which is a fine launch about 90ft. in length and 11ft. 6in. width. This is fitted with a large motor, nominally of 60-horse power, but it was only working at about 17-horse power on Wednesday. The object of the form of gearing and the rotation of the motor is not, perhaps, very obvious.

The secondary battery plates are of the grid order, with plugs of rolled up lead pushed into the meshes, and these plugs are said to take the form of round-edged cubes after they have expanded and tightened themselves in the square holes into which they are pressed. This form of plate is said to be able to stand the jolting much better than any other forms that have been tried, but necessary improvement is admitted.

AMERICAN ENGINEERING NEWS.

Inland navigation.—A ship canal convention is to be held at Peoria, Ill., on October 11th, to discuss a proposition for a through navigation scheme to connect the Mississippi river with the great lakes. Such a route, accommodating large vessels, would be in continual competition with the railroads, and would compel the latter to give reasonable rates without the intervention of legislation. The Mayor of Chicago has appointed a number of gentlemen to represent the city at the convention. The question of providing a ship canal from Lake Erie to the Ohio river is being agitated, the matter having originated in the fact that Illinois is working in earnest to carry out the Hennepin canal scheme, while Minnesota is discussing a ship canal between St. Paul and Duluth. It is proposed to ask Congress to undertake the construction of the canal, and if this proposition is favourably received, the work can be carried out at greater rapidity and at minimum cost by utilising portions of the present systems of canals.

Iron shipbuilding in Maine.—At Bath, Me., a company will probably undertake the building of iron steamships. The New England Shipbuilding Company has had an offer made by Rhode Island parties to build an iron steamer of 2000 tons for about 225,000 dols. Several other boats are to be built, and the orders will probably be secured by the Bath firm. The plant will cost about 25,000 dols. Bath has already quite a reputation for sailing vessels, and the new industry will considerably increase the town's importance.

Aluminum bronze for heavy guns.—Mr. A. H. Cowles will shortly read a paper at the Naval Institute on the use of aluminum bronze for heavy guns, and a discussion of the paper is invited from home and foreign metallurgists and ordnance experts. It is claimed that the metal is almost perfect for gun purposes, and that guns can be made either by the Rodman or Deane process of casting, that it will be superior in tensile strength and ductility to the best mild steel forgings, that such guns cannot be burst by four times the powder pressure in built-up steel guns, and that the cost of the plant would only be about one-third that of the plant for built-up guns, while the manufacture of plant and guns would be done in a fourth of the time. It is estimated that guns can be cast from this bronze at 20 per cent. less cost than forged guns of steel.

Railroad and telegraph men going abroad.—About a dozen railroad men will shortly leave Atlanta, Ga., to take positions on the Panama Railroad, where competent men are in demand and are given good salaries. Engineers get from 150 dols. to 175 dols. per month, paid in gold; conductors, 175 dols., and tram hands, 75 dols. per month. There is considerable excitement among telegraph operators over the chance of getting employment by the Barker syndicate for service in China on the telegraph and telephone lines, for which the syndicate recently obtained a concession. According to report, the managers offer 200 dols. per month and free passage to China.

The iron railroad.—A rather remarkable railroad in Ohio is the iron railroad, a line operated between Ironton and Center in Lawrence County. According to the annual report recently filed with the Railroad Commissioners, the road was built in 1853, the main line being thirteen miles long; branches and side tracks which have since been added make the entire length of single track twenty-three miles. The capital stock first subscribed was 600,000 dols., and has remained unchanged. The cost of the construction of the road was 500,000 dols., and of equipment 99,500 dols. During the past year the road has earned 85,762·67 dols., or 47·3 per cent. of the earnings; the net earnings of the road were 45,177·69 dols. A semi-annual dividend of 2½ per cent. was declared last year, as has been the case since the road was built. The road runs through bare hills along its entire route, and its chief business is hauling pig iron and iron ores. For its size it is the best paying road in the State.

The cotton crop.—A drought which prevailed in Tennessee, Mississippi, Arkansas, and Alabama from the middle of July into September has been most disastrous to the cotton crop, and what had promised to be the largest yield ever known within the district was cut short by drought, rust, and worms to below an average crop. In the section of the country tributary to New Orleans the damage to cotton is estimated at 50 per cent. Last year the crop was only a half one, and the present state of affairs will result in considerable loss, if not ruin, to many planters.

Round roof cars.—The present form of roof of the average American railroad car has been frequently a source of discussion, and has been very generally condemned. It consists of an upward sloping ceiling along each side of the car, and a monitor roof, or clearstory, in the middle, the latter being about 18in. higher than the ceiling, and occupying about half the width of the car. Along the sides of the monitor roof are placed the ventilators, and the lamps are hung in it. This form of roof is structurally weak, owing to the breaking up of the roof arch by the space for the monitor roof, and in some of the older cars the lamps were so high that passengers next the window were in the shade. This defect does not obtain in modern cars, where, as in the Pullman, Mann, and Wagner cars, side lamps are used to give effective light for reading, but the form of roof remains incorrect. Recently some railroads, among them the Boston and Lowell, Boston and Main, and the Boston and Albany, have commenced to build round roof cars, with satisfactory results. The springing of the roof is a little higher than at present, and the curve is sharp at the sides and flatter on the top, the height of the roof being the same as with the old form. The interior effect is lofty and airy, giving the idea of a very high roof, and the exterior appearance is pleasing. Other roads will probably adopt this form of roof.

Steel guns.—The advertisement for proposals for the manufacture of three classes of steel cannon for the Government only brought out two proposals, and the reason seems to have been that when manufacturers received the specifications, and found that they required that the guns must be cast whole, that any bubble or flaw would involve the rejection of the work, and that the loss in that case would fall on the contractors, they did not care to submit bids. The specifications called for three 6in. cast steel experimental guns, one of Bessemer, one of crucible, and one of open-hearth steel. Each casting was to weigh about 8 tons in the rough, so that a 5 or 6-ton gun could be worked out of it. The castings to be faultless, and to be of a quality to stand the most severe tests. The two bids were from the Pittsburg Steel Casting Company, of Pittsburg, Pa., and the Standard Steel Casting Company, of Philadelphia, Pa. At the former works five castings of steel for rolls were made recently, weighing 7 tons each, and the results as to quality were very satisfactory. Only one proposal was received by the Navy Department for twenty-two sets of steel forgings for 6in. breech-loading rifles, about 136 tons. The bid was from the Midvale Steel Company, of Philadelphia, Pa., 123,284 dols. for the forgings, rough-bored and turned, oil treated and annealed; or 108,799 dols. if the tubes, jackets, and trunnions are rough-bored and turned by the Department.

The London Association of Foremen Engineers and Draughtsmen.—The usual monthly meeting of this Association was held on Saturday, the 1st inst., at 7.30 p.m., at the Cannon-street Hotel, when the chair was occupied by the vice-president, Mr. W. P. Heath. After the private business was over, Mr. Heath introduced a discussion on gas-burners by reading a short paper on "The Welsbach Incandescent Gas Lamp." He stated that of the many inventions for gas lighting introduced during the last few years there is none that approaches the ideal of what a light should be so near as the incandescent system. Several incandescent burners or lamps have been tried and abandoned soon after the exhibition stage, the cause of failure being chiefly the difficulty of obtaining a material capable of withstanding the intense heat necessary to produce incandescence. The "Lewis" light a few years ago seemed to have solved the problem, but the platinum gauze mantle forming the medium of incandescence proved too short-lived, as well as very expensive in renewing, and the demand for the lamp was restricted. The latest candidate for public favour is the invention of Dr. Carl von Welsbach, of Vienna, and bears his name. It has been in successful use for some time on the Continent, and is now coming into use in this country, and possesses the merit of burning common coal gas with cleanliness and economy. The lamp exhibited to the meeting had been carefully tested, and found to give a light equal to sixteen sperm candles, with a consumption of 2½ cubic feet of gas per hour, without smoke and with very little heat. Mr. Heath described the arrangement of this lamp, and method of producing the incandescent mantle, which gives out a steady, brilliant light, similar to an electric lamp. He stated that his own experience had shown him that this lamp required careful handling in fixing, as the mantle is very brittle, and if it is broken the lamp is useless. He did not think it well suited for movable gas fittings such as chandeliers or swing brackets, but should be put on brackets without movable joints. Neither should it be exposed to draughts, which cause the light to flicker and burn blue, even although protected by a glass chimney similar to the Argand burner. He did not think the lamp in its present state would be largely patronised by the numerous class of small consumers, but that its cleanliness would introduce it to those who had been deterred from using gas on account of the deterioration it caused to books, pictures, and decorations. A discussion followed, in which Messrs. Bartle, Smith, Bale, and Shorburn took part, and it was agreed that the lamp was an advance on previous efforts. It was also stated that a newer arrangement was likely to come before the public soon, in which the difficulty of the brittle mantle had been overcome. A vote of thanks was accorded to Mr. Heath, and the meeting closed.

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

(*From our own Correspondent.*)

The ironmasters' quarterly meetings at Wolverhampton yesterday and at Birmingham to-day—Thursday—attracted a large number of ironmasters and merchants from all parts of the country, but they were not very brisk. Anticipations at the openings of the meetings were not particularly sanguine, but exception may be taken to sheets, which showed a steadiness of growth wholly favourable to the declaration of any advance. Prospects were declared by most sheet firms to be very satisfactory. As to pigs, it may be said that the northern markets are now recognised as having some influence over Staffordshire, and makers from those districts were repeatedly questioned upon the probable course of the northern iron trade.

As the result of the gatherings, those finished iron prices which are regulated by the decisions of the "list" houses, such as the Earl of Dudley, Messrs. Wm. Barrow and Sons, John Bradley and Co., the New British Iron Co., John Bagnall and Sons, Philip Williams and Sons, and Noah Hingley and Sons, remain unaltered. The standard for marked bars of £7 per ton has now ruled without a break for eighteen months; sheets and plates of the best houses are £8 10s. to £9 per ton nominal.

The Earl of Dudley's prices are unchanged at: bars, lowest quality, £7 12s. 6d.; single best, £9; double best, £9 10s.; and treble best, £12 10s. Strips and hoops and angle iron are: lowest quality, £8 2s. 6d.; single best, £9 10s.; double best, £11; and treble best, £13. His lordship's rivet and tee-iron are: single best, £10; double best, £11 10s.; and treble best, £13 10s. Strips and hoops of ⅜in. and 20 gauge are £9 2s. 6d., lowest quality; £10 10s., single best; £12, double best; and £14, treble best; while ⅜in. is £10 12s. 6d; £11 10s.; £13; and £15, respectively.

Messrs. William Barrows and Sons and the New British Iron Company confirmed the quotations given in last week's report. The "Mitre" iron of Messrs. P. Williams and Sons was 5s. per ton less on the list than the prices of other firms, "Mitre" first quality bars being £6 15s., and the firm's second quality £5 15s.

Messrs. John Bradley and Co. maintain their exceptional quotations of £9 10s. for all bars above ⅜in. Hoops they quote £8 10s., which is 20s. above the standard of the market; and sheets and plates £10, which is 30s. advance upon the best makers. Rounds and squares up to ⅜in. are quoted £8, a rise upon other firms of 20s. per ton.

The list of John Bagnall and Sons is: bar, 1in. to 6in., £7; 6½in. to 9in. flat bars and 4½in., £8 10s.; 4⅝in. to 4¾in., £9; 4⅞in. and 5in., £9 10s. As to rounds only, the large sizes are—5⅛in. and 5¼in., £10; 5⅜in. to 5½in., £10 10s.; 5⅝in. to 5¾in., £11; 5⅞in. and 6in., £11 10s.; 6⅛in. to 6½in., £12 10s. Hoops and angles are quoted at £7 10s., and rivet iron at £8 10s. to £9 10s., according to quality. Sheet quotations are—20 gauge, £8 10s.; 24 gauge, £10; and 27 gauge, £11 10s.; but these quotations are hardly more than nominal. Boiler plates are £8 10s., £9 10s., £10 10s., and £14 10s., according to quality.

As to unmarked iron, the testimony of the quarterly meetings was that the orders arriving are small, and are placed at prices which leave but little margin of profit. These being cleared off with despatch, makers find that they have no great provision for the next few months. The solicitude which merchants are showing for the prompt execution of their lines is, however, satisfactory. It is a clear indication of the lowness of their stocks, and this fact may in some measure improve makers' position. The most important orders which are being placed by merchants are for the Colonies, India, and South America. United States representatives also showed some anxiety to buy to-day sheets and hoops.

Common bars enter upon the new quarter at £4 15s. to £5; merchant bars, £5 10s.; and second-class branded bars, £6. Very common descriptions of hoops were to-day £5 to £5 5s. at works, and better sorts, £5 7s. 6d. These rates are practically the same as those ruling at this time last year. Hoops last year being quoted £5 10s., are now down 5s. per ton; but gas strip has risen from 2s. 6d. to 5s. per ton, the quotation last October having been £4 15s. to £4 17s. 6d. Gas strip, as was to be expected, is stronger at this season of the year, when the demands of the wrought tube makers are usually expressed with more freedom. Narrow descriptions were to-day quoted up by the associated makers 2s. 6d. to 5s. per ton, making the present price £5 per ton at works. Circulars announcing this advance have been issued. How far, however, makers will be able to maintain it is matter for question.

The advance of from 2s. 6d. to 5s. per ton which during the past few weeks has been upheld by the leading black sheet makers is now becoming more general. The flood of orders now on the market allows of makers commanding their own rates, and it was with difficulty that any new contracts could be placed in Birmingham 'Change at figures approximating those of a month ago. Singles were mostly £6 2s. 6d. to £6 5s. per ton for galvanising purposes, £6 7s. 6d. to £6 10s. for doubles, and £7 7s. 6d. to £7 10s. for lattens. Prices of sheets generally may be said to be very strong and prospects excellent. The galvanisers are exceptionally brisk on colonial, South American, and Indian account. The shipments last month were the largest on record, being 14,363 tons, against 10,093 tons for the corresponding month last year, an increase of 4270 tons. The orders are rather irregularly distributed. Some works have more orders than they can conveniently execute, while others have some of their vats still unemployed. Prices are very strong.

Messrs. Walker Brothers, galvanised roofing manufacturers, Walsall, have obtained orders from the Taff Vale Railway Company to erect some large iron roofs at Cardiff. Messrs. H. P. Skidmore and Co., of the Atlas Tube Works, Netherton, near Dudley, who recently purchased the works and plant of the Birkenhead Galvanised Iron Co., intend to themselves carry on the business on the old lines. Messrs. G. Adams and Sons, of the Mars Ironworks, Wolverhampton, have received information this week that they, along with two other galvanising firms in London, have received a first-class award at the Adelaide Exhibition for galvanised sheets. This is very satisfactory for so young a firm.

A heavy demand for steel of all descriptions is being experienced, and much confidence was imparted to the trade this—Thursday—afternoon on 'Change by the reports of the considerable activity in distant centres. A good inquiry was expressed for Bessemer blooms, billets, and tin bars. Prices were very firm at £4 10s. for Bessemer blooms and billets imported from Wales; £4 17s. 6d. for Siemens blooms; £5 for Bessemer tin bars; and £5 7s. 6d. for Siemens ditto, delivered in this district. The reports given by the Welsh, Cleveland, West Coast, and Scotch steelmakers present at to-day's meeting were of the most gratifying description. This, as regards the extent of the demand. As to prices, these were not reported of satisfactorily. Than steel, no department of the quarterly meeting looked more encouraging. It was universally agreed that demand was increasing, and some works have more than they can do.

Local steel masters announced a strong sale for Bessemer and Siemens-Martin metal. The makers of cultivating and edge tools are increasingly valuable customers, and solid steel hammers are now fast displacing steel-faced tools. For local-made steel of this description, in which special attention is paid to the proportion of carbon, £7 per ton is demanded. Bessemer bars are quoted £6, and Siemens-Martin bars of guaranteed quality, £9. Frost stud steel bars of reliable quality are also £9. Bessemer billets of 2in. and upwards are £4 12s. 6d. The prices of steel sheets of local make vary widely, but good Bessemer singles are obtainable at £7 to £7 10s., while cold rolled and close annealed sheets of 28 gauge range up to £9 10s.

Basic steel, of Staffordshire make, was in large demand at:—Blooms and billets, £5; bars and angles, £6 5s.; channel sections, £6 5s. to £6 7s. 6d.; guides and tank-plates, £6 15s. to £7; and

best boiler plates, £7 5s. For soft steel manufactured by the open-hearth basic process, the Staffordshire Steel and Ingot Iron Company asked this afternoon some advance upon basic prices proper. Prospects were declared to be excellent.

United States orders were on the market for Bessemer steel sheets. 800 tons in a line was the extent of one inquiry, and the sizes and gauges were said to be more acceptable than usual. The exact price which the buyers were prepared to give was not allowed to transpire.

Pig iron prices show an absence of firmness. This may be due to consumers having covered themselves forward. Some consumers, indeed, have booked their requirements for the first quarter of next year. Some pig makers, having but few orders on their books, are compelled to make concessions in order to secure new business.

Midland brands are in moderate request, but prices are by no means satisfactory. At present rates makers allege that they can secure very little profit at the furnaces. Quotations are this week 37s. 6d. to 38s. at consumers' works for Derbyshires, 41s. for Lincolnshires, and 36s. 6d. upwards for Northamptons. A twelve-month ago prices were 35s. 6d. to 36s. for Northamptons, 35s. 6d. to 37s. for Derbyshires, and 39s. to 39s. 6d. for Lincolnshires.

Native all-mine pigs are re-declared at last quarter's prices by the Lilleshall Company of Shropshire and the leading Staffordshire makers, namely, 50s. to 52s. 6d. for hot-blast sorts, and 75s. for cold-blast. Part-mines were to-day an average of 40s. easy, and cinder pigs 29s. to 30s. Current prices of all-mines show no change on a year ago.

Hematites are stronger than any other pigs on the market, in consequence of the heavy demand which makers are experiencing at the furnaces from the steel masters. Some good local sales are reported as having taken place during the last few weeks. West coast sorts delivered here are named 54s. to 56s., according to the brand, and Tredegar hematites are 52s. 6d. for first sorts, and 45s. for second.

The Galvanised Iron Trade Association met this—Thursday—afternoon in Birmingham, and advanced prices 10s., making the quotation £11 delivered Liverpool. Spelter has advanced £2 in the last five months, and is now £16 12s. 6d. per ton; tin-plates in good demand; Welsh coke sorts, 13s. per box; and charcoals, 15s. to 16s. delivered Liverpool. American merchants offered 3d. to 6d. per ton less; wasters, 1s. under coke.

According to the Board of Trade returns for September, the industries in which the South Staffordshire district is most largely interested show a conspicuous improvement. During the month iron and steel exports increased over the corresponding period last year 99,133 tons, or about 33½ per cent., in quantity, and £588,484, or 34·3 per cent. in value. For the nine months the total quantity exported was 3,110,791 tons, being an increase of 603,708 tons, or 24 per cent., in quantity, over a year ago, and the value was £18,579,845, an increase of £2,191,616, or 13 per cent. In pig and puddled iron the increase in value this September over last is £62,857, or 27 per cent.; in bar and angle it is £27,204, or 25 per cent.; in railroad, £145,738, or 47 per cent.; in wire, £21,485, or 53 per cent.; in telegraph wire, £120,176, or a very large percentage; in cast and wrought, £53,068, or 18 per cent.; in hoops and sheets, £96,227, or 41 per cent.; in old iron, £30,970, or 118 per cent.; in unwrought steel, £26,630, or 19 per cent.; in unwrought tin the increase is very small, and in tin, plates it is £105,023, or 33 per cent. In railroad iron, pig iron, and tin-plates the increase is mainly due to the improved United States demand.

The following are the details :—

Iron, steel, and tin.	Month of September. 1886. £	1887. £
Pig and puddled	230,561	293,417
Bar, angle, &c.	106,541	133,745
Railroad	308,900	454,638
Wire	40,371	61,856
Telegraphic ditto	37,964	158,140
Cast and wrought	290,211	343,279
Hoops, sheets, &c.	233,745	329,972
Old iron	26,965	57,935
Steel, unwrought	136,476	163,106
Tin, unwrought	46,046	46,757
Tin-plates	318,274	423,297
Hardware and cutlery	255,257	267,629
Machinery	688,072	728,994
Steam engines	231,611	217,650

A serious boiler explosion occurred on Tuesday night at Messrs. Brown and Freer's ironworks at Brierley Hill, occasioning the death of six men, and resulting in serious injuries to many others. The boiler, which was about 17ft. high and 9ft. in diameter, had been working at low pressure—about 30 lb. — and was put down about twenty years ago. The effect of the explosion was the blowing out of two plates, but otherwise the boiler is intact. It is somewhat remarkable that the boiler was examined on Monday by an inspector, and it is stated that the day after the explosion Messrs. Brown and Freer received a favourable report.

As the result of a canvas by the nailmakers on strike in the Hales Owen district, a joint meeting of masters and men will be held at Birmingham to-day. Attempts will then be made to settle the dispute, and having in view the approach of the winter weather, the operatives will no doubt be prevailed upon to somewhat moderate their demands.

Alluding to a statement in a Birmingham contemporary, with regard to Government stores, that "the prices paid in many cases would not pay for steel alone of the requisite temper," Messrs. W. and G. Ashford and Winder, of Birmingham, write that "in the factories of which we know anything the endeavour for generations has been to get hold of the very best material obtainable, and to work it up in the best way; and we believe it would pay the Government to do so, as well as it pays private firms."

The South Staffordshire Mines Drainage Commissioners have resolved to acquire new parliamentary powers, which shall enable them to meet certain difficulties in the course of their operations which they have to encounter. Besides requiring a more distinct interpretation of the arbitrators' powers, they desire to obtain power to prosecute colliery owners who make fraudulent returns of the quantities of minerals raised by them, and upon which the rates are from time to time levied. The commissioners also desire that some independent body other than themselves should be constituted the court of appeal, to hear the half-yearly appeals against the tonnage assessments on these returns from the owners. The chief opposition which the new Bill is likely to encounter will be from localities now outside the mines drainage operations of the Commission, but some of whom the Commissioners propose to tax on the ground that they contribute water to the pumping engines. The new Act will not propose, however, any increase in the present rating powers. But for the operations of the Commissioners, South Staffordshire must long ago have been drowned out.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—There is still nothing satisfactory to report with regard to the iron trade of this district. Business continues to drag on in much the same depressed manner as I have had to record in my "Notes" for some time past, and any prospect of improvement seems to be quite as remote as ever. The continued downward tendency in Scotch warrants, and the very unsatisfactory quarterly meeting at Middlesbrough this week, have necessarily an unfavourable effect upon the market here. Buyers not only hesitate about entering into transactions of any weight, but they are encouraged to press for concessions in price which makers are not in a position to entertain, and this checks business being done. In hematites the tone is also weak, and although makers hold nominally to late quoted rates, firm offers for anything like quantities could be placed at very low figures. Business in finished iron has been somewhat in abeyance, pending the result of the Birmingham quarterly meetings, although no appreciable alteration in price is anticipated. The whole outlook of trade continues discouraging, and a despondent feeling with regard to the future prevails pretty generally.

At the Manchester iron market on Tuesday there was only the slowest possible business doing. Pig iron was very bad to sell, and the tendency of the market generally was in the favour of buyers. For local and district brands makers were not quoting any lower prices—in fact, in some instances Lincolnshire makers showed a disposition to hold out for a slight advance upon the very low prices that have recently been taken; but the actual business doing in either Lancashire, Derbyshire, or Lincolnshire iron was extremely small, and the tendency to stiffen in the last-named brand is no indication of any actual improvement. For a long time Lincolnshire has been by far the cheapest iron in this market, and the margin between the price at which it has been sold, and the quotations for Lancashire and Derbyshire irons has been altogether disproportionate. At the minimum price of 37s., less 2½ per cent., for No. 3 foundry delivered equal to Manchester, a considerable weight of Lincolnshire iron has recently been sold, and makers being now well booked, and having no weight of stocks on hand, seem to have come to the conclusion that there is no real necessity why they should be such excessively low sellers, and the result has been that on Tuesday an advance of 6d. to 1s. per ton was quoted on the lowest prices that have lately been taken. Although this upward movement is in opposition to what is the present general tendency of the market, it is very probable that makers will hold out for some advance, and buyers who have had low offers pending are showing more anxiety to place out orders. For Derbyshire foundry 40s., less 2½ per cent., remains the minimum quoted price, and Lancashire makers still hold to 38s. 6d. and 39s. 6d., less 2½ per cent., for forge and foundry delivered equal to Manchester. Middlesbrough iron is decidedly easier in price; although some of the makers hold to late quotations, there is no difficulty in buying good-named brands of foundry at 42s. to 42s. 6d. net cash delivered equal to Manchester, and in Scotch iron there is continued underselling at much below makers' nominal quotations.

Good No. 3 foundry brands of hematites are still quoted by most of the makers at 52s. 6d., less 2½, delivered into the Manchester district; considerably less than this is, however, being taken to effect sales in quantity, and I have heard of very low figures being taken.

In the steel trade, for the better class of manufactured goods, such as boiler plates, engineers' bars, &c., the demand continues to show a falling off, and lower prices than have recently been ruling have to be taken to secure orders.

The manufactured iron trade, helped up by a continued fairly good shipping demand, is kept steady, and prices remain at above £4 17s. 6d. for bars, £5 5s. for hoops, and £6 7s. 6d. to £6 10s. for sheets delivered into the Manchester district. Some possibility of an advance in sheets at the Birmingham meeting this week has been talked of, but although makers are for the present mostly full of orders, they have very little work ahead, and there is nothing in the future to maintain higher prices, the prospects for the ensuing winter being still anything but hopeful.

Amongst engineers there is here and there a rather more cheerful tone, and I hear reports from pretty good authority that both in railway and Government work there are some very fair orders coming out, both for tool makers and engineers. Just at present tool makers are decidedly slack, and will be quite ready to go in for any new work that is to be got, with the usual result that prices will be cut down to the very lowest possible point. There has been a little work giving out to locomotive builders, but nothing to effect any appreciable improvement upon the continued generally very depressed condition of this branch of trade. Boilermakers, stationery engine builders, and machinists, are still fairly off for work, but taking trade as a whole it continues in only a very unsatisfactory condition.

The efforts to which I referred last week to re-open negotiations for a settlement of the Bolton engineers' strike have, like all previous attempts in the same direction, resulted in a failure; even the offer by one firm outside the Employers' Association to give a partial advance, not having been accepted by the men, has now been definitely withdrawn, and there seems to be nothing now before the men on strike but to "grin and abide," as one of their own representatives put it to me, during the winter. The employers continue to fill up their shops with other men, and even should the old hands who are out on strike offer to return to work on the old terms, only a small proportion of them would now be able to find employment. During the period that the employers have been shorthanded through the strike, they have had to allow orders to pass them; there is consequently less work in the shops than there otherwise would have been, and for the work they have the employers have now generally got sufficient men.

The introduction of appliances whereby the commonest mineral oil can be effectually and economically utilised for lighting purposes, particularly in large engineering works, or for colliery pit banks and general outdoor operations, is making rapid progress, and the lights so produced have already proved their superiority over either gas or electricity for the special purposes enumerated above. Last winter I drew attention to the "Lucigen" light, which was being introduced into several of the large engineering works in this district, and which has since become well known. The working of this light has now been considerably improved by dispensing with oil tanks for each light, and providing a central tank, from which a number of lights can be supplied, the oil being forced by the compressed air, which is one of the essential features in producing the light, through pipes to each separate light, which can be fixed in any position that is desired. This, of course, involves an increased pressure of air, but it is a great improvement, as it does away with the necessity of filling a number of separate tanks, which, being attached to the light, were frequently in very inconvenient positions, and in their place having one large tank placed in a convenient position for refilling, with a compressor attached in a very compact arrangement. I understand that a number of the lights with this improved arrangement are being fixed up at the works of Sir Joseph Whitworth and Co., and the Lancashire and Yorkshire Railway Company is also having a number of the new lights erected, the oil for which will have to be forced through pipes for exceptionally long distances. It is only to be expected that so successful a utilisation of the common cheap oils for lighting purposes should lead to other appliances being designed having the same object in view, and a new lamp has just been introduced by A. C. Wells, of Manchester, which promises to be a strong competitor with the "Lucigen." This new lamp burns the commonest mineral oils, out of which it produces a brilliant white light, but it is different altogether in principle and action to the "Lucigen," and dispenses altogether with the use of compressed air. Wells' apparatus consists of a portable oil tank, in the centre of which is a steel cylinder perforated at the bottom, and containing a ram actuated by a coil spring. When the spring is wound up, the ram is lifted to the top of the cylinder, and a supply of oil is sucked into the cylinder through the perforations at the bottom; the action of the spring then gradually forces the ram down in the cylinder, and a clack at the bottom closes up the perforations. The pressure exerted by the ram forces the oil through a pipe to a specially-constructed burner, the principal feature of which is that the oil before reaching the burner has to pass through tubes upon which the flame of the light impinges; the heat thus communicated to these tubes converts the oil into gas, which, as it reaches the burner, is mixed with a certain proportion of air, and, as already stated, burns with a brilliant white light. Several of these new lamps are being used at Southport to afford light to the workmen in the construction of the lake for the new marine park. The principle of the lamp is not new, as the conversion of oil into gas by passing it through tubes over the burner was adopted in oil lamps used in Manchester works years ago, but with the arrangement introduced by Mr. Wells, a very handy portable lamp, giving a brilliant light at a minimum of cost, has been secured.

Any real activity in the coal trade is still chiefly confined to the better qualities suitable for house-fire consumption, and in these a fairly good business is being done, with a slight improvement in prices, as compared with those being taken last month, in most cases being realised, although there has been no general definite advance. Other descriptions for iron making, steam, and engine purposes still meet with only a slow sale, and are plentiful in the market, with prices not appreciably any higher. At the pit mouth best coal averages 8s. 9d. to 9s.; seconds, 7s. to 7s. 6d.; common house fire coals, 5s. 6d. to 6s.; steam and forge coals, 5s. to 5s. 6d.; burgy, 4s. 6d. to 5s.; best slack, 3s. 6d. to 4s.; and common, 2s. 6d. to 3s. per ton.

In shipping there is a little more doing in house fire coals, with rather better prices being got, but steam coals are bad to sell, and where any advance has been attempted on these, sellers have found themselves practically cut out of the market, steam coal delivered at the high level, Liverpool, or the Garston Docks, being still readily obtainable at 6s. 6d. to 6s. 9d. per ton.

Barrow.—There is no improvement to note in the amount of trade doing in hematite pig iron, but the trade is firmer, and there is reason to believe that the low prices at which lately orders have been negotiated by holders of second-hand stocks will soon give way to prices more closely assimilated to the official quotations of makers. The latter have been reduced as compared with two months ago from 45s. 6d. to 43s. 6d. per ton net, f.o.b., and it is fully expected that in a short time the influences now at work will bring back prices to 45s. 6d. for parcels of Bessemer iron net, f.o.b., in parcels of mixed numbers. Stocks are not larger than they have been, and the rate of output is maintained, but there is some talk of blowing furnaces out if prices do not move upward. The steel trade is very busy, and as orders are largely held, it is expected to continue so both in the rail and other departments. Prices of steel are steady, and heavy sections of rails are quoted at from £4 2s. 6d. to £4 5s. per ton net, f.o.b. Shipbuilding is still a very quiet trade in Barrow. I understand that the Barrow Shipbuilding Company will, in all probability, secure orders from the Spanish Government for the construction of nine steam launches. There is a good enquiry for sailing and steamships, but prices are very low. Engineers are only doing a moderate general trade, and in the marine department orders are scarce. Iron ore is firmer, and is now quoted at from 9s. to 12s. 6d. per ton net at mines, according to quality; but most raisers are declining to sell in view of the changes which may be effected by the increase in freights on Spanish ores imported to this country. The coal and coke trades are steady and brisk.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The distinct improvement in the American demand for the goods manufactured in the Sheffield consular district has been made pretty plain by the return to September 30th, to which date the United States trading year is made up. For the twelve months ending that date, the exports reached a value of £846,723, against £523,187 for the corresponding period of 1886. Cutlery was exported to the value of £200,692, and steel to the value of £307,164, against £178,506 and £255,312 respectively for 1886. Every quarter of this year shows an important advance on the corresponding quarter of 1886. During the quarter ending June last, the United States took in steel alone a value of £83,184. Manufacturers complain, however, that prices are not so remunerative as they ought to be, and there is no doubt that a large proportion of the exports is in secondary grades of steel, while a considerable quantity is in Bessemer blooms.

Though there was a large increase in the demand for house coal during September, in anticipation of the advance usually made in October, it is instructive to note that the collieries doing a business by rail with London did not forward so much as last year, when coalowners found trade bad enough. During September last the quantity of coal sent to London by rail was 590,449 tons, as compared with 602,607 tons for September of 1886. For the nine months completed in September the weight was 5,213,700 tons, against 5,248,773 tons for the first nine months of 1886. The decrease on the month is thus 12,157 tons, and on the nine months 35,073 tons. Messrs. Newton, Chambers, and Co., Thorncliffe collieries, again head the list, their deliveries into London last month having reached 31,483 tons. Clay Cross Colliery comes next with 22,439 tons; Langley Mill third with 15,308 tons; then follow Blackwell, 15,099; Grassmoor, 12,954; Sheffield Coal Company, 12,778; J. and G. Wells and Co., Eckington, 11,505. Gas coal has been sold at 3d. and 6d. less per ton than last year. Yorkshire collieries doing a trade with Hull have, on the other hand, greatly added to their business. During September the quantity of coals taken to the great Yorkshire port was 166,684 tons, against 145,488 tons in the corresponding month of 1886. For the nine completed months of the year the weight was 1,334,336 tons, as compared with 1,018,600 tons for the similar period of 1886. Once more Denaby Main tops the list with 16,448 tons, against 10,504 tons in September, 1886, Manvers Main coming next with 11,808 tons, against 8888. The export trade during September from Hull amounted to 80,620 tons, against 62,670 tons for September of last year; for the completed nine months of the year, 651,540 tons, against 455,806 tons for the corresponding period of 1886. Sweden and Norway show the largest increase; last month 22,841 tons, against 13,148 for September, 1886. Large increases are also shown by France, South Africa, California, South America, Belgium, Denmark, Egypt, Gibraltar, and Holland. The decreasing markets are chiefly Germany and South Russia.

The unwrought steel sent to all markets during September amounted to £163,105, against £136,476 for September, 1886. Once more the United States exhibit the principal increase, the value of steel sent there having increased from £49,862 in September, 1886, to £75,868 last month. France and other markets show a slight improvement. For the nine months to September last the value was £1,639,050 against £975,621 for the corresponding period of 1886. The United States have already taken this year a value of £957,777; to the corresponding date last year the value was £347,688.

Hardware and cutlery were exported last month to the value of £267,529, as compared with £255,257 for September, 1886; for the nine months of 1887, £2,118,169; for the nine months of 1886, £2,128,235. There is thus an increase on the month and a decrease on the nine months. The increasing markets last month were Germany, Holland, United States, Argentine Republic, British Possessions in South Africa—from £3865 to £9302—East Indies, and certain minor markets. Less has been done with Russia, France, Spain and Canaries, Foreign West Indies, Brazil, British North America, and Australasia.

The directors of the Manchester, Sheffield, and Lincolnshire Railway Company having gratefully declined the generous offer of their men to contribute a week's pay by way of showing their practical sympathy in connection with the Hexthorpe collision, a meeting has been held at Mexborough, where the proposal originated, and a resolution passed in favour of devoting the money to a superannuation fund. This was the suggestion thrown out by Sir Edward Watkin, the chairman. The amount thus obtained, if the idea of the fund meets with general approval, will not fall short of £12,000.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The quarterly meeting of the Cleveland iron trade was held at Middlesbrough on Tuesday last. Although the attendance was fully up to the average, but little actual business was transacted,

and the tone was far from satisfactory. The better feeling reported last week has not continued, as buyers are now holding back, and prices are weaker. Both makers and merchants show more eagerness to sell than for some time past, and although the former will take 33s. 3d., and the latter 33s. per ton for prompt delivery, they do not succeed in making any sales. This is equivalent to a reduction of 3d. per ton on last week's prices. For delivery to the end of the year several makers are now willing to accept 33s. 6d. Forge iron is not so plentiful as No. 3, and is therefore somewhat firmer in price. About 31s. 9d. per ton is the figure usually demanded.

Stevenson, Jaques, and Co.'s current quotations: "Acklam Hematite," mixed Nos., 45s. per ton; "Acklam Yorkshire," Cleveland, No. 3, 34s. 6d.; "Acklam Basic," 35s.; refined iron, 48s. to 63s., net cash at furnaces.

Warrants have naturally fluctuated with makers' iron. The price current remained at 33s. during last week, but on Tuesday it fell to 32s. 7½d.

The stock of pig iron in Messrs. Connal and Co.'s Middlesbrough stores is again declining. The reduction for the week ending the 7th inst. was 1769 tons.

Shipments from the Tees are this month scarcely up to the average. The quantity sent away up to Monday evening last was 27,464 tons, as against 26,331 tons in the first ten days of September last.

The prospects of the finished iron makers are no brighter. There is no improvement in the demand, and prices are as low as ever. Iron ship-plates can be bought at £4 7s. 6d. per ton, and common bars at £4 10s., free on trucks at makers' works, less 2½ per cent. discount.

The steel works in the district are all very busy, but prices have not yet risen. Steel ship-plates are offered at £6 per ton; angles at £5 10s.; and rails of heavy section at £4 2s. 6d., all net cash at makers' works.

The Cleveland ironmasters' statistics for the month of September have just been issued. They show that ninety-seven furnaces were at work, being two more than during the previous month, and thirteen more than during September, 1886. Of the ninety-seven furnaces fifty-two were producing Cleveland and forty-five hematite and other kinds of iron. The make of Cleveland iron was 108,806 tons, and of hematite, &c., 101,228 tons. The stocks of pig iron in the whole district have increased by 2089 tons during the month.

The iron and steel industries of the Cleveland district are undoubtedly suffering, or, at all events, their development is being retarded for want of regular lines of steamers to the principal foreign and colonial markets. An enormous amount of money has been expended in improving the river Tees, and in constructing the Middlesbrough docks; and still more is likely to be spent in this way in the immediate future. The result of these improvements is that first-class steamers up to at least 3000 tons burden can easily trade to and fro, and many such are continually entering and leaving the Tees. But these magnificent vessels are, so far, almost always chartered to carry full cargoes. That is, when they leave they are filled with pig iron, rails, or sleepers, from one particular exporter, and to be delivered to one particular consignee. When they enter the river they are usually in ballast. It is not open to exporters generally to make use of these opportunities of exporting, and these vessels, though sailing very frequently, do so as they happen to be loaded, and not at stated intervals. This irregular kind of transport is all very well for articles such as rails, sleepers, and pig iron, the demand for which is usually in one or more complete cargoes, but it does not at all suit such trades as those in bar iron, plates, castings, engineering work, and so forth. Such goods must often be sent in small quantities to suit the requirements of customers; and unless producers are prepared to supply in this way orders for large quantities do not follow. Consequently, unless transport facilities suit the needs of the consumer equally with the article he wishes to buy, he refuses to do business. Indeed, export trade follows transport facilities.

In other words, if from one port there are regular lines of steamers leaving, say weekly, for a certain foreign or colonial market, and from another port there are not such facilities, it is clear that the iron works and factories in the neighbourhood of the former port would have a better demand for their produce than those in the neighbourhood of the latter. Merchants and exporters are in the habit of receiving indents, ordering goods which must not exceed a certain limit of price when delivered to the buyers. These prices will not usually bear any addition for railway carriage from the maker's works to a distant port, at least not if there should be any competing producer situated near to such a port. Consequently, export trades manufacturers begin, grow, and flourish best near to and around those ports whence regular lines of steamers ply to foreign and colonial markets.

Those who are connected with the Cleveland iron trade are beginning to find out that they are not so well situated as their Glasgow competitors in this respect. Cleveland can produce many kinds of iron and iron goods—and perhaps, steel and steel goods—cheaper than Glasgow can. But if Cleveland has to send them to Liverpool or London for exportation, and Glasgow can ship in the Clyde, it is clear that the latter may have the advantage in the long run.

It is this difficulty which the members of the Cleveland Iron trade hope to remove before long. Their attention is now upon the subject, and it is to be hoped that it will not be allowed to flag until they have inaugurated some regular lines of steamers, by which small or large quantities can equally be sent abroad. The only regular line at present is that from the Tees to London.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The Glasgow warrant market has been much depressed this week. The past week's shipments were below the average, amounting to 7575 tons against 10,175 in the corresponding week of last year. In consequence of the smallness of the shipments, and also because the current inquiry from abroad is unsatisfactory, the prices of warrants fall to a lower point than has been touched for a considerable time. There were large speculative sales, however, and the anticipated efforts hitherto made to support the market seemed to be wanting. Of the past week's foreign shipments, 1300 tons went to the United States, and 1055 to Canada, there being no pig iron whatever sent either to Italy or to France. The coastwise shipments were 2905 tons. Since last report one furnace has been relighted at Eglinton Ironworks, but another has been put out at Clyde, so that there remain eighty-three in blast as compared with sixty-nine at the corresponding date. The quantity of pig iron being sent into store is now somewhat on the increase.

Current values of makers' pigs are about 6d. a ton lower than they were a week ago:—F.o.b. at Glasgow, Gartsherrie, No. 1 is quoted, 47s., No. 3, 43s.; Coltness, 52s. 6d. and 43s. 6d.; Langloan, 48s. and 44s. 6d.; Summerlee, 50s. and 42s.; Calder, 48s. and 41s. 6d.; Carnbroe, 43s. and 39s. 6d.; Clyde, 45s. 6d. and 40s. 6d.; Monkland, 43s. and 38s. 6d.; Govan at Broomielaw, 42s. 6d. and 38s. 6d.; Shotts at Leith, 47s. 6d. and 44s. 6d.; Carron at Grangemouth, 52s. and 44s. 6d.; Glengarnock at Ardrossan, 47s. 6d. and 40s. 6d.; Eglinton, 42s. 6d. and 38s. 6d.; Dalmellington, 43s. 6d. and 39s. 6d.

Arrivals of Cleveland pigs at Grangemouth for the past week are 7660 tons, against 6610 tons in the corresponding week, and there is a total increase in these imports for the year to date of 19,229 tons.

Spanish ore is still offered on 'Change in Glasgow at the recent advanced rates; but so far the inquiry on the part of consumers does not appear to be pressing. The advanced quotations of ore have, however, excited a certain influence on the speculative market of Cumberland hematite pigs, the inquiry for warrants being better within the last few days than for several weeks past. There seems to be an impression that hematite is now so low that it may be purchased in tolerable confidence as an investment.

Makers of malleable iron continue busy on orders recently placed, although current inquiries are said not to indicate an immediate renewal of activity among purchasers. The current price of bars is £4 15s., less 5 per cent. discount. Unbranded iron for the Indian market is quiet at £4 7s. 6d.

It is understood that 8000 tons of 27in. water pipes required by the Dundee Water Commissioners, will be placed with Glasgow founders, who have made the lowest tenders.

Although there is no absolute lack of employment at steel works, inquiries are rather slow at the moment. Orders for shipbuilding are, however, expected in fair quantity at an early date. Steel makers complain that prices are being forced down by the action of middle men, who have been systematically bearing the market, and it is stated that merchants are offering to undertake contracts for the supply of steel at about 5s. a ton below makers' quotations. An order for steel angles has recently been accepted as low as £5 per ton.

A steel-making firm in the neighbourhood of Glasgow has nearly ready for use a couple of the Batho basic furnaces described by Mr. Wailes at the recent meeting of the Iron and Steel Institute at Manchester.

During the past week there was shipped from the Clyde steel goods to the value of £2934; iron manufactures, £52,523; machinery, £13,771; sewing machines, £1855; and locomotives, £3748.

The shipping department of the coal trade has been less active in the past week, although the shipments do not exhibit a very large falling off. They amounted to 84,366 tons, as compared with 85,141 in the corresponding week of 1886. Prices of main coals are a shade easier at the ship's side, but other qualities are practically unchanged.

There is now a pretty large and constantly increasing business being done in the West of Scotland in briquettes or patent fuel. The finer qualities of these briquettes, made from the dross of steam coals, are in request for the Russian and Indian and other markets, and home consumers are also increasing their orders for these and the more common qualities for both household and manufacturing purposes.

The Broxburn Oil Company has this week evicted from their dwellings a number of shale miners, with their families, on account of the men continuing the strike against a reduction of wages, which has now lasted upwards of three months.

A four days' conference of miners' delegates was held this week at Edinburgh with the object of considering, amongst other matters, the advisability of restricting the output of coal. Mr. Burt, M.P., presided and addressed the miners.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

A slight improvement for the better has begun to characterise the coal trade, and some large shipments have taken place, showing a good total both at Swansea and Cardiff. Newport maintains a fair average, but may soon be expected to advance as the house-coal season comes on. So far house coal has not shown much activity, though the total of this week is certain to indicate an improvement, even if prices remain unaltered.

The opinion on 'Change at Cardiff this week was that another week's good demand for steam coal will bring about a better price than now obtains.

I am glad to know that large quantities of steam coal have been sold for as much as 9s. per ton, again, in certain quarters where a persistent refusal to sell at lower rates has been maintained. A few of the leading coalowners, numbering half a dozen, and owning the best seams, would soon improve prices by following the same course, and it is not unlikely to be adopted. Prices are ranging for house coal, large, from 6s. at pit. Rhondda No. 3 is quoted at 8s. 3d. Small steam is in feeble demand at present; prices seem dropping to 3s., when some business may be done. At present quotations are numerous, from 3s. 3d. to 3s. 6d., but there are more sellers than buyers in the market.

Patent fuel remains in its usual slack condition. Cardiff despatched last week about an average, 3000 tons. Swansea appears quite unable to come up to its old mark, though last week over 7000 tons were despatched, and this is a more promising total, if it can be kept up.

Pitwood is quoted at 15s. 3d. Cardiff, 16s. 3d. Swansea. Stocks are coming to hand, but on the face of the winter, which is already showing itself, prices are certain to go up higher.

Coal returns for the three quarters of the year are to hand, and unless the present quarter shows a great advance upon the trade of the month of September the year's total promises to exhibit a falling off. The total coal from Cardiff for foreign shipment during the quarter has been 5,485,892 tons; from Swansea the total has been 629,194 tons; and from Newport, 1,738,856 tons. September month was a bad one all round, the decrease from all ports in Wales being close upon 68,000 tons.

The returns for the three quarters testify to an improving iron trade, 54,000 tons in round numbers having been shipped at Cardiff, 178,000 tons at Newport, and 15,000 tons at Swansea. The most active month was July, when Newport sent 26,000 tons, Cardiff 10,000, and Swansea nearly 2000 tons, all shipped coastwise and foreign.

In addition to this, a good trade is being done in home districts, and the continued prosperity of the tin-plate works reacts favourably on the iron and steel trade.

The iron ore trade is looking up, and shipments are flowing in from Bilbao and Carthagena. The Bilbao rate to Cardiff for a large quantity is now 5s., price of ore at lowest figure 12s., so the margin is not a great one for sellers, commission agents, and the usual *et ceteras*.

Last week the new patent blast furnace in course of erection at Blaina by the Pyle Furnace Company was blown in, and is doing well. It was erected specially for the manufacture of spiegeleisen and ferro-manganese.

A beginning has been made at the Iron and Steel Works, Treforest, and new works are projected at Briton Ferry. Prices remain the same as last week, lowest price for heavy section steel rails £4 5s. per ton.

I had an opportunity of seeing a steel bar that had been bent cold in various ways at Cyfarthfa lately. The test was a crucial one, and the result such as to impress one with the high character of the steel made at these works.

A miners' union has been established at Cyfarthfa and a start made on Saturday, and the colliers elsewhere are moving in the matter of improved association gatherings. A good deal of reticence is observed by them. It is evident the impression exists that resolute co-operation will be necessary this winter, and hence the preparations. The soberest advice to them will be to aim at a peaceful solution.

The Tyne district, which is lamenting at the demand for Welsh coal over their own, would be the only ones to benefit by a paralysis of the Welsh industry.

Tin-plate continues in good demand at prices a shade easier than last week. The quotations on 'Change at Swansea this week were as follows:—Coke, iron I.C., 12s. 9d.; Bessemer up to 13s. 3d.; Siemens, 13s. to 13s. 6d.; ternes not inquired after; wasters, 1s. less than prices. Over 41,000 boxes left Swansea last week, and of these America took 19,000 tons. The make last week was a few thousand boxes over sales, and stocks are a trifle heavier in consequence.

Quotations at the Exchange on Tuesday, Swansea, were:—Pig, 48s. 6d.; blooms, £4 5s.; bars, Bessemer, £4 15s.; Siemens, £5 2s. 6d. delivered at buyers' works; cash, less 2½.

A good seam of coal was struck a few days ago at Llansamlet by the Birchgrove Company.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

The reports from all quarters speak hopefully of the present position of the iron markets here, which have remained pretty much in the same condition as last week reported, there being, neither in demand nor prices, any appreciable differences worth noting. The Silesian market is firm. A better quality of pig iron has begun to be made by some of the furnaces from imported ores, but its production does not pay as yet on account of high freights. It is quite time this step has been taken, for the wrought iron produced from pig made from native ores was certainly not too good in quality. Forge pig is noted M. 47 and foundry 52 to 54 p.t. The manufactured iron trade is very brisk, and all the rolling mills full of orders for plates, girders, angles, bars, and sheets, both black and galvanised. Common bars cost M. 135 to 140; best ditto, 145 to 150; and coke plates, 170 p.t.

In the Rhenish-Westphalian districts, so far as they have been reported up to now, the balance-sheets up to the end of June of the iron and steel works are much more favourable than had been expected, the second half of the business year, from January, having compensated for the losses on the first half. As regards the special branches, the ore trade is satisfactory, still the demand in the Siegerland has fallen off a little, while that for Luxemburg minette for German account is brisk, and the price in consequence somewhat higher, costing M. 3·10 p.t. calcined. There has also been a larger import of Spanish ores lately, which have here gone up in price too. The pig iron trade keeps steady and brisk, nearly all the output for the quarter is sold and stocks are diminishing, though the production has been greatly augmented, and so long as the forges continue to be such good customers, prices would not be likely to recede, even if no convention existed. The lowest sort of spiegel costs now M. 51 p.t., and the home and foreign demands are good. Forge pig is very firm and in excellent request, though, of course, few transactions are passing, because so little remains to be disposed of. Prices are not likely to move now till after the new year turns. There is no alteration to note in foundry, Bessemer, or basic pig. The business done in manufactured iron is still most lively, whilst prices remain most thoroughly firm, though they do not give as much profit as they ought to do, because pigs are dearer, and wrought iron is not able to follow suit. The inauguration of the "German General Rolling-mill Convention" is anxiously awaited. Boiler and tank plates are looking up. The new spirit distillery laws, which came into operation on the 1st inst., have given quite a fillip to the tank-making trade both in Westphalia and Silesia, for nothing like the quantity of holders required for storing the spirits could be supplied within the above date, and at one time it was a question whether the date should not be prolonged. As the plate mills are included in the above-named convention, the former base price of M. 150 has been raised to 152 p.t. The sheet mills are so busy they cannot undertake to deliver under four to six weeks, either in Westphalia or the Siegerland. Parcels have changed hands at M 140 p.t. There is no change to record in the wire rod trade. The steel works have orders in hand to keep them some months employed, and as noted last week, an accession to them may soon be expected, for tenders for 10,000 t. of steel rails and accessories are out for the State Railways at Bromberg, and for Berlin, 1200 t. of transverse iron sleepers, 5410 t. of steel rails, and 1319 t. of fish-plates, nails, and bolts. Tenders for three narrow-gauge tank locomotives have been given out at Cologne. Eight offers for them came in, ranging from M 15,240 to M 23,000 at the manufactory. The wagon works are still in want of orders. The Wurtemberg State Railways have sent out tenders for 47 passenger coaches, 50 covered, and 50 open goods trucks. The home demand will keep some of the machine-shops pretty well and regularly employed for some time to come, while others are only moderately busy, still, more so than a short time back; but much, if any, improvement in prices cannot be noticed. The brass founders, during September, were all fully engaged, and after completing their current orders, had still from two and a half to three months' work in hand. The present prices of castings are, for red brass, M 1·70; bronze, M 1·65; phosphor bronze, 1·75; and smithed copper, 2·70 p. ko.

At Schalke, in Westphalia, a new steel works is being established, as well as one for making tinned plates, the latter to come into operation towards the end of the year, and the other a month or two later. Two hundred workmen will be employed in them. Here it may be remarked that in Austria a few days ago a second tin-plate works was set to work, so that now there may be in all eight to nine such works on the European Continent. At present this will not affect England's export trade, which it now has entirely in its own hands, and in finish and quality is without a rival. Still, there is no saying how long this may be the case, if the Welsh workmen do not in due time become wise enough to avoid strikes and awkwardness in the future, by which means alone this pre-eminence can be retained.

The position of the French iron market is still unsatisfactory. It is quite impossible to understand why the Paris houses should persist, as they have done for months past, in depressing prices, whilst an excellent demand for all kinds of building and constructive iron exists. At last, however, it has roused the ironmasters in several centres to approach one another and in unison to emancipate themselves from this fatal state of things. A meeting lately held at Maubeuge—Nord—plainly showed that each works represented had enough orders in the books to keep the works tolerably well going, so it was unanimously determined to send out circulars to their customers declaring a rise in merchant iron of 15f. p.t. The trade journals do not call this a rise, but only a natural return to reasonable prices. There is a full demand for plates, and prices are exceedingly firm. Nominally, girders at Paris are 120f., and bars 130f., but large concessions are obtainable on good orders. Boiler plates are noted 190f. The machine and constructive iron shops are, as a rule, well employed; the Nord Railway Company has given out an order for 6000 freight trucks.

The Belgian iron market continues very firm, and as all the works are well supplied with orders for a long time, the less favourable news from America does not affect the trade. Luxemburg forge pig is not to be bought for less than 43f. for the first quarter of 1888. One more furnace in the Charleroi basin has been put into blast. Plates have gone up 5f. per No., so that No. 2 stands now at 140; No. 3, 160; No. 4, 230 p.t. The State has just given out orders for 8000 t. of steel rails, 460 wagons, and several locomotives. The coal market is firm and brisk, but no rise in prices has yet taken place.

News comes from St. Petersburg that a project is on foot, which meets with every financial and other support, to form share companies out of all the present large ironworks in Poland and similar ones in the interior of Russia, to which new blast furnaces are to be added, and then unite them all into one whole. The organisation is to be such that all materials which are requisite for the carrying-out of the plans shall be supplied in the country itself, without having recourse to England, Germany, Austria, or France, as hitherto was the case when new works were established in Russia or Poland. The late augmentations of Customs duties has inspired this scheme, which Petersburg financial organs hold will pay good dividends. *Nous verrons!*

The Italian Government has chartered the cable steamers International and Kangaroo to proceed to Massowah for the purpose of producing distilled water from sea-water and storing it for the use of the troops in that locality. The distilling plant in both ships will be of the most improved and powerful description, and the installation has in both cases been entrusted to Messrs. John Kirkaldy, the contractors for these specialities, who fitted most of the ships employed in the Ashantee, Cape, Zulu, Egyptian, and Soudan Expeditions, and whose system of construction enables them to carry out work of this kind for large and sudden requirements.

AMERICAN NOTES.

(From our own Correspondent.)

New York, October 1st.

Copper exports to date this year are 9,000,000 lb. refined, against 13,544,350 lb. same time last year, and 29,460,357 copper matte and ore this year, against 43,770,086 for same time last year. Tin-plate receipts to date this year are 2,600,000 boxes, against 2,800,000 boxes same time last year. Copper is 10·40 to 10·60. Oilmen are making large purchases of tin-plate at the prices ruling.

The iron trade is quieter than usual. One reason was the recent failures, another the scare started in financial circles; the third is the fact that August was an active month, and many bought then who in former years bought in September. The general volume of business is 14 per cent. in excess of last year to date, and 19 per cent. greater than for same time 1885. So far as railroad and commercial statistics show, the present lull in iron will be productive of good, in arresting an upward tendency in prices. Consumers now see that the producing capacity is fully equal to all probable requirements. Stocks of foreign material in consumers' hands are large, but new orders will soon go abroad. Old steel and iron rails are 22 dols.; wire rods, 41 dols.; slabs, 31·50 dols.; new steel rails, 36 dols. to 38 dols.; bar iron, 2c. per lb.; foreign Bessemer, 20 dols.; American, at furnace, 19·50 dols. The rolling mill capacity of the country is fully engaged, and the indications are that the extraordinary activity will continue all winter.

NEW COMPANIES.

The following companies have just been registered:—

Sanders, Son, and Payne, Limited.

This is the conversion to a company of the business of Sanders, Son, and Payne, of Sparkbrook, Birmingham, brassfounders, ironfounders, and hardware merchants. It was registered on the 3rd inst., with a capital of £10,000, in £5 shares, with the following as first subscribers:—

	Shares.
*J. C. Sanders, Sparkbrook, Birmingham, brass-founder, &c.	1
*Wm. Sanders, Sparkbrook, Birmingham, brass-founder, &c.	1
*G. Payne, Sparkbrook, Birmingham, brass-founder, &c.	1
*G. R. Payne, Sparkbrook, Birmingham, manager	1
J. T. Johnson, 17, St. Luke's-road, Birmingham, jeweller	1
A. Payne, 36, Main-street, Birmingham, ironmonger	1
A. T. Wright, Sparkbrook, Birmingham, commercial traveller	1

The number of directors is not to be less than three, nor more than seven; qualification, 20 shares; the first are the subscribers denoted by an asterisk. The company in general meeting will determine remuneration.

Swaledale Mining Association, Limited.

On the 4th inst. this company was registered, with a capital of £1000, in £1 shares, to acquire and work mines, no particular locality being mentioned. The subscribers are:—

	Shares.
J. H. King, M.R.C.S., 3, Thornhill-crescent, N.	1
C. E. S. Flemming, Bath	1
J. K. Lamb, 16, Great Winchester-street, accountant	1
W. Green, 20, Hornsey-rise-gardens	1
G. A. Hughes, 101, Bishopsgate-street, share-broker	1
J. Jones, 12, Richmond-road, Uxbridge-road, N., traveller	1
N. F. Rees, R.N., 23, Park-place, Greenwich	1

The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first, any shareholder being eligible; remuneration, £3 3s. to the chairman, and £2 2s. to each director for every board meeting attended.

Whitehall Electric Supply Company, Limited.

This company was registered on the 5th inst., with a capital of £200,000, in £5 shares, to carry on in all branches the business of an electric light and power company. The subscribers are:—

	Shares.
Major J. T. Wright, 12, Cadogan-terrace, S.W.	200
G. Dibley, Streatham	200
J. Gutteridge, J.P., 14, Tufnell Park, N.	200
J. W. Hobbs, Streatham	200
L. B. Burns, Winchester House	200
H. G. Wright, Bletchley	200
J. S. Balfour, J.P., Wellesley House, Croydon	200
J. E. H. Gordon, 28, Collingham-place, electrical engineer	50

The number of directors is not to exceed seven; qualification, fifty ordinary shares; the subscribers are to nominate the first; remuneration, £1000 per annum.

Inventions and Agency Company, Limited.

This company was registered on the 4th inst., with a capital of £2000, in £1 shares, to act as agents for British, American, and foreign manufacturers, inventors, and others, for the sale and disposal of goods, specialities, and machinery of every description. The subscribers are:—

	Shares.
D. Murray, 57, Penn-road-villas, N.	1
F. P. Doremus, 51, Kelly-street, N.W.	1
R. W. Wilson, 42, Norwood-road, S.E.	1
A. Legi, 31 and 32, Kirby-street, E.C., engineer	1
W. Jameson, 60, Cambridge-square, Hyde Park, surgeon dentist	1
W. Wood, 43, White-street, Bethnal-green	1
J. W. Columbine, 2, Carlisle-street, Soho-square, manufacturer	1

Registered without special articles.

Liverpool Block Works, Limited.

This is the conversion to a company of the business of block makers and shipsmiths, carried on by Rooke Brothers and Co., at 17, Goree Pazzas, and 12 and 13, Nova Scotia, Liverpool, and at J. Transit Shed, West Basin, Cardiff. It was registered on the 7th inst., with a capital of £4000, in £1 shares, fully paid up. The subscribers are:—

	Shares.
H. C. S. Rooke, 17, Goree Pazzas, Liverpool, manufacturer	1
H. A. Rooke, 17, Goree Pazzas, Liverpool, manufacturer	1
H. Baxter, 17, Goree Pazzas, Liverpool, manufacturer	1
H. H. Rooke, 148, Grove-street, Liverpool	1
W. McKenzie, 4, Butler-street, Liverpool, block maker	1
Wm. Linaker, 54, Essex-street, Liverpool, shipsmith	1
R. E. Pearce, 4, Keat-square, Liverpool, block maker	1

Registered without special articles.

British and Foreign Steamship Company, Limited.

This company was registered on the 7th inst., with a capital of £200,000, in £100 shares, to acquire from Messrs. Rankin, Gilmour, and Co., of Liverpool, at cost price, the steamships Saint Oswald, Saint Fillaus, and Saint Regulus. The subscribers are:—

	Shares.
Robt. Rankin, 67, South John-street, Liverpool, merchant	1
J. Rankin, 67, South John-street, Liverpool, merchant	1
W. Strang, 63, Fenchurch-street, merchant	1
J. Rankin, Bryngwyn, Hereford	1
J. Gilmour, Kennoway, Fife	1
J. A. Strang, 40, Lee-terrace, Blackheath, clerk	1
J. H. P. Strang, 40, Lee-terrace, Blackheath, clerk	1

The management of the company is vested in the firm of Rankin, Gilmour, and Co., of Liverpool.

Queensland Shaft Sinking Company, Limited.

On the 8th inst. this company was registered, with a capital of £10,000, in £1 shares, to carry on in Queensland and elsewhere the business of shaft-sinking by machinery, and other mechanical operations in connection with the opening or development of mines. Under an agreement of the 1st inst., provides for the purchase from John Beith, of Berwerdy, Pontypridd, Glamorgan, of two complete sets of air compressors, receivers, engines, boilers, tripods, stretcher bars, twelve sets of rock drills, the necessary tools, blacksmiths' fires, drilling machines and lathe, with a sufficient stock of steel and iron necessary for the full equipment of the above-named plant. The purchase consideration for the same, together with the right to use the patented system of shaft-sinking as adopted by the firm of Beith Brothers, is £3000 in cash and £3000 in fully-paid shares. Mr. John Beith will proceed to Queensland, and continue there as the company's manager, at a salary of £500 per annum, and will also be entitled to 10 per cent. of the net profits in each year in which the shareholders receive 10 per cent. The subscribers are:—

	Shares.
*T. Mills, 3, Gracechurch-street, miner	1
*C. M. Jacobs, C.E., Redesdale-mansions, N.W.	1
*J. Wallace, 81, Gracechurch-street, merchant	1
*J. McDonald, 78, Gracechurch-street, miner	1
H. Tozer, 28, York-street, W., solicitor	1
R. B. B. Clayton, 85, Edith-road, West Kensington, agent	1
C. C. Rawson, 64, Cromwell-avenue, Highgate	1
T. H. Lewis, 88, Bishopsgate-street Within, clerk	1

The number of directors is not to be less than three, nor more than five; qualification, 100 shares; the first are the subscribers denoted by an asterisk; remuneration, £500 for the first year, afterwards as the shareholders in general meeting shall decide.

Wimborne Minster Waterworks Company, Limited.

This company was registered on the 6th inst., with a capital of £8000, in £10 shares, to supply pure water to the neighbourhood of Wimborne Minster, Dorset. The subscribers are:—

	Shares.
Major-General R. H. Truell, C.B., Ornslow, Wimborne	5
C. E. Ellis, Wimborne, wine merchant	10
G. F. Huntley, Wimborne, druggist	5
G. S. Tasker, Wimborne	10
W. Wghesmith, F.R.C.S., Wimborne	5
W. Symonds, Wimborne, draper	10
R. Elcock, Wimborne, builder, &c.	10

Registered without special articles.

THE SEWAGE WORKS OF WIESBADEN.[1]

These works, which were modelled upon those of Frankfort, and have been in operation since May, 1886, have, in consequence of the favourable results obtained by upward filtration at Essen, been so far modified as to take an intermediate place between the two systems. The sewage water is made to part with a large portion of its impurities by being passed upwards and downwards through chambers arranged in front of the tanks. It goes through a previous straining process to remove all floating substances, and is then mixed with the precipitants—milk of lime—in a chamber where a thorough agitation is effected by blowing in air. The sewage then passes over a weir into a narrow chamber, at the bottom of which it is led through small openings in the division wall into a second chamber, which it traverses in an upward direction, and then over a second screen-wall and down through a third chamber into a fourth, through which it ascends into the depositing tanks, three in number. These are deepest at the front, and can be used together or separately. The construction of the tanks is shown in plan and section; each division is 30 metres in length by 10 metres in width. The mean speed of the sewage flow through these tanks is from two to four millimetres per second. The total quantity of sewage dealt with per diem is estimated at 6500 cubic metres, with a tank accommodation for five hours' flow.

[1] Proc. Inst. Civ. Engineers.

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.

401A. Steering Apparatus, R. M. Fryer, London.—11*th January*, 1887.—[Received 6th October, 1887. This application having been originally included in No. 401, A.D. 1887, takes, under Patents Rule 23, that date.]

401B. Cooling Stoke-holes in Steamships, R. M. Fryer, London.—11*th January*, 1887.—[Received 6th October, 1887. This application having been originally included in No. 401, A.D. 1887, takes, under Patents Rule 23, that date.]

401c. Bearings for Propeller Shafts, R. M. Fryer.—11*th January*, 1887.—[Received 6th October, 1887. This application having been originally included in No. 401, A.D. 1887, takes, under Patents Rule 23, that date.]

4th October, 1887.

13,387. Grommets, J. G. Tongue.—(*J. Boyle, United States.*)
13,388. Gas-making Apparatus, J. Atkinson, London.
13,389. Sleeve or Cuff Links, F. R. Baker, Birmingham.
13 390. Self-feeding Rivetting Machine, T. Brining, Leeds.
13,391. Lasting Boots and Shoes, T. Brining, Leeds.
13,392. Ornamenting Perambulators, W. H. Brassington, Manchester.
13,393. Measuring Machines, H. L. Müller and W. Adkins, Birmingham.
13,394. Umbrellas, M. A. Dobbs, Kilkenny.
13,395. Valves for Regulating the Flow of Fluids, H. Kilburn, Bishop Auckland.
13,396. Revolving Wood Shutters, A. Wells, London.
13,397. Cleaning Butter, &c., J. J. Bailey, King's Cliffe.
13,398. Guillotine Paper-cutting Machine, W. Powrie, London.
13,399. Archimedean Railway, W. West, Leeds.
13,400. Sight-feed Lubricators, A. Thomson, Rotherham.
13,401. Presses for Copying, Printing, &c., J. Marsh, London.
13,402. Furnaces for Malt Kilns, C. C. Clausen, London.
13,403. Horse-clipping Machine, F. Rose, Bebington.
13,404. Slotting and Shaping Machine Tools, R. Younger, Newcastle-on-Tyne.
13,405. Scotch Carpets, T. Cuthbertson, Glasgow.
13,406. Drawing Apparatus, H. Marle, Birmingham.
13,407. Drawing Apparatus, H. Marle, Birmingham.
13,408. Diaries, C. H. Knight, London.
13,409. Plumbic Oxide, S. C. Rowell and J. W. Newell, London.
13,410. Metallic Boxes, E. A. Jahncke and H. W. Herbst, London.
13,411. Shirts, H. H. Lake.—(*L. F. Turner and A. L. Crawford, United States.*)
13,412. Fan Blowers, A. H. Berry, London.
13,413. Controlling Railway Switches, H. H. Lake.—(*C. S. Drake, United States.*)
13,414. Cane, C. Lange, London.
13,415. Cardboard Boxes, H. Henschel, London.
13,416. Horseshoes, A. Fieldsend and J. Jackson, Sheffield.
13,417. Signal Posts, F. B. Hart and G. Parkinson, London.
13,418. Chains, I. Barker, Birmingham.
13,419. Skates, A. Hunnable, London.
13,420. Electrodes for Electric Batteries, E. L. Mayer, London.
13,421. Combined Lifting Latch and Bolt, R. L. Burkitt and G. W. Green, London.
13,422. Supporting Ships' Boats, G. Dawkins, London.
13,423. Instrument for the Cure of Sand Cracks in the Hoofs of Horses, &c., J. Arnold, London.
13,424. Playing the Piano, G. Paul Le Dan, London.
13,425. Horse Collars, C. Block, London.
13,426. Braces, C. C. Gilmore, London.
13,427. Pencil Sharpeners, E. A. Gay, London.
13,428. Feeding Oil to Lamps, &c., D. Moore and F. S. Moore, London.
13,429. Regulating the Supply of Liquid to Cisterns, C. H. Jolliffe, London.
13,430. Drop-hammers, A. J. Boult.—(*F. M. Leavitt, United States.*)
13,431. Furnaces, W. P. Thompson.—(*W. B. Wright and E. T. Williams, United States.*)
13,432. Lubricators, J. G. Fisher, Manchester.
13,433. Lasts, A. W. Wilson, London.
13,434. Fire-proof Curtains, R. Bradshaw, Manchester.
13,435. Hosiery, H. Howe, London.
13,436. Gas Engines, H. Lea, London.
13,437. Weighting with Metal the Internal Stopper, T. P. Green, London.
13,438. Domestic and Pocket Filters, P. P. Kipping, London.
13,439. Neckties, M. Christoph, London.
13,440. Electric Batteries, G. Zanni, London.
13,441. Oil Lamps, J. G. Henrich, London.
13,442. Cabins in Ships, W. H. Wilson and W. J. Pirrie, London.
13,443. Suspender End, W. W. Horn.—(*C. Voorhis and A. Shenfield, United States.*)
13,444. Sewer Ventilation, W. Webb, Twickenham.
13,445. Dyeing Textile Materials, W. J. S. Grawitz, London.
13,446. Boots and Shoes, A. W. Cooper, London.
13,447. Electric Railways, A. L. Lineff and E. H. Bayley, London.
13,448. Perforating Machines, H. E. Newton.—(*E. B. Stimpson, jun., United States.*)
13,449. Horse Shoes, A. Debry, London.
13,450. Gas for Heating and Illuminating, S. R. Dickson, London.
13,451. Flexible or Spring Heels for Boots, G. E. Swan, United States.
13,452. Developing the Muscles of the Arm, W. M. Smith, London.

5th October, 1887.

13,453. Branding Soap, J. H. Barraclough, West Hartlepool.
13,454. Fittings for Incandescent Electric Lamps, R. T. Turnbull, London.
13,455. Combination Steel and Carver Fork, H. G. Carr, Sheffield.
13,456. Audible Signalling for Railways, H. J. Peddie, Glasgow.
13,457. Bars from Scrap Iron, J. H. Smith and J. Talbot, Birmingham.
13,458. Draw-bar Hooks for Railway Carriages, F. C. Cowney, Yorkshire.
13,459. Cleaning Grain, A. M. Robinson and J. Ward, Liverpool.
13,460. Sifting Ground Grain, A. M. Robinson and J. Ward, Liverpool.
13,461. Automatic Portfolio Folding Frames, J. G. Smyth, Bury St. Edmunds.
13,462. Coke Ovens for Securing Bye-products, T. Nicholson, Beeston.
13,463. Couplings for Railway Wagons, J. A. Wood, Keighley.
13,464. Self-closing Hydrant, J. Newey, Moseley, near Birmingham.
13,465. Ironing Machines, H. Fabian, London.
13,466. Bracket for Blind Rollers, J. Farmer, Bristol.
13,467. Cement, W. Smith, Dublin.
13,468. Steam Boiler and other Furnaces, E. Meanock, Manchester.
13,469. Repeating Gun, J. Bowden, Cardiff.
13,470. Powder Puffs, &c., A. M. F. Thatcher, London.
13,471. Polishing, &c., Leather, E. H. Chapman, Leicester.
13,472. Closing or Opening Doors, &c., J. Coppard, London.
13,473. Doubling or Twisting Yarns, J. Farrar, Halifax.
13,474. Ornamentation of Metallic Mounts, &c., A. Heath, Birmingham.
13,475. Fountains for Bird Cages, F. C. T. Voigt, Birmingham.
13,476. Arm and other Rests, &c., G. Worrall, jun., Dundee.
13,477. Sprinklers, E. Morton and J. W. Manley, Stalybridge.
13,478. Footsteps for the Spindles of Spinning Frames, W. Bodden.—(*J. H. McMullan, United States.*)
13,479. Combination of Ingredients as Embrocation, T. S. Mayhew, London.
13,480. Electric Automatic Fire-alarms, H. A. C. Saunders and A. C. Brown, London.
13,481. Cutting the Edges of Rolls of Paper, J. J. Carr, London.
13,482. Railway Smoking Carriages, H. Ratcliffe, London.
13,483. Kilns for Iron Ore, &c., W. E. Carrington and J. Brocklehurst, London.
13,484. Detachable Non-vibrating Handle Bars for Bicycles, T. F. Pearse, London.
13,485. Internal Annular Grooves, A. Cheesbrough, London.
13,486. Screw Bottle Stopper, T. S. James, London.
13,487. Pumps for Ice-making Machines, F. B. Hill, London.
13,488. Velocipedes, F. O. Seyd, London.
13,489. Seats of Velocipedes, C. T. Austen, London.
13,490. Cutting Screws, W. Ross and J. Bilbie, London.
13,491. Lamb Frames, W. Langham, London.
13,492. Military Bridges, Fire-escapes, &c., J. Glover, Manchester.
13,493. Steam Lifeboats, J. M. Emerson, Liverpool.
13,494. Mackintoshes, &c., P. A. Hale, Liverpool.
13,495. Covers for Closing Holes in Vessels, H. D. Nance, Liverpool.
13,496. Bedsteads, &c., W. A. Jones, Liverpool.
13,497. Swing Doors, H. Smith, London.
13,498. Cleaning Tramway Rails, J. C. W. Pauwels, London.
13,499. Soaps, W. E. Heath, London.
13,500. Chemical Fluid Ink Erasers, J. W. Tallmadge, New York.
13,501. Door Name Plates, C. H. Dirks, London.
13,502. Vessels to Imitate Earthenware, &c., T. B. Gibson, London.
13,503. Buckles for Braces, &c., T. Walker, London.
13,504. Boots and Shoes, H. Dunkley, London.
13,505. Washing Photographic Negatives, &c., J. H. Jefferies, London.
13,506. Cold-drawing Metal Bars, &c., E. Sandkuhl, London.
13,507. Churns, J. Llewellin, London.
13,508. Flushing Cisterns, W. Ballantine and R. Blackie, Glasgow.
13,509. Telephonic Apparatus, C. Bell.—(*L. M. Ericsson, Sweden.*)
13,510. Microphones, W. Genest, London.
13,511. Gas-burners, J. Lewis, London.
13,512. Transmitting Reciprocatory into Rotary Motion, O. Neuhäuser, London.
13,513. Ornamental Nail, J. J. Robinson and E. Hanff, London.
13,514. Felt Hats, C. Vero, London.
13,515. Pianos, F. Hempel, London.
13,516. Desk Flaps and Seats, W. P. Wilmot and C. Jarrett, London.
13,517. Garment, &c., Hook, H. H. Lake.—(*C. H. Thurston, United States.*)

6th October, 1887.

13,518. Adjustable Calendar Match-box, &c., L. Emanuel, Birmingham.
13,519. Insulators for Overhead Telegraphs, &c., R. C. Douglas, Bradford.
13,520. Cultivators, H. and E. G. Lander, Mere.
13,521. Gas-holders, W. Gadd and W. F. Mason, Manchester.
13,522. Production of Aluminium, C. A. Burghardt and W. J. Twining, Manchester.
13,523. Beds, G. and E. Woods, Liverpool.
13,524. Fastening Windows, W. C. Hearn, New Malden.
13,525. Ovens, A. T. Woodward, Birmingham.
13,526. Bearings for Axles of Rollers of Machines, A. Hist, London.
13,527. Twisting, &c., Yarns, J. Robertshaw, W. and F. Shaw, Halifax.
13,528. Traps for Drains, &c., J. M. Thrush, Ripley.
13,529. Pumps, J. Morley, Upper Saltley.
13,530. Pipes, &c., E. F. Bour, London.
13,531. Automatic Water Gauge, W. Jagger, Sheffield.
13,532. Stands for Teapots, W. H. Andrew, Sheffield.
13,533. Preventing the Picking Bowl Leaving the Lappet Point in Looms, J. Williams and T. Catlow, London.
13,534. Treatment of Blast Furnace Slag, T. C. Hutchinson, Stockton-on-Tees.
13,535. Raising Venetian Blinds, J. S. Orton, Balsall Heath.
13,536. Glass for Rollers in Machines, J. Willis and A. T. Allen, Sheffield.
13,537. Brick-making Machinery, T. C. Fawcett, Halifax.
13,538. Clocks, E. Davies, Birmingham.
13,539. Purification of Sewer Gas, &c., J. Bates, Liverpool.
13,540. Paraffin Lamps, M. Morland, Liverpool.
13,541. Fog Signals for Railways, J. Cope, Sheffield.
13,542. Stoppering Bottles, J. Taylor, Birmingham.
13,543. Aerating Liquids, J. Cox, London.
13,544. Carburetters, P. Jensen.—(*J. Leede and V. D. Stockbridge, United States.*)
13,545. Pipes, Cigar Holders, &c., E. Trieloff, London.
13,546. Drying Malt, &c., J. Black and R. Hamilton, Glasgow.
13,547. Recording the Duration of Races, H. F. Marryat, London.
13,548. Buckles for Dress Belts, T. B. Wilkins and R. Reacord, London.
13,549. Foot Pads, T. P. Lomas, Birmingham.
13,550. Rearing-mothers, T. Christy, London.
13,551. Boots and Shoes, T. Smith, London.
13,552. Flexible Coupling for Shafts, C. F. Archer, London.
13,553. Game, R. Firth, London.
13,554. Clothes-horse, S. M. and L. G. Chinnery, London.
13,555. Engines Worked by Mineral Oils, J. H. Knight, London.
13,556. Cuff Protector, T. Bickle, Cornwall.
13,557. Straining Tea, E. Coiffe, France.
13,558. Electrical Conductors, P. Everitt and P. R. Allen, London.
13,559. Indian Clubs, W. A. Woof, London.
13,560. Machinery for Compressing Iron, J. Butler, London.
13,561. Electricity Meters, H. W. Kolle, London.
13,562. Brakes, R. Morris and J. Wood, London.
13,563. Advertising, H. Agar, Whitby.
13,564. Nut-lock, W. W. Horn.—(*R. T. Sylvester, Canada.*)
13,565. Regulating Device for Wires of Instruments, W. Fisher, London.
13,566. Cameras for Photographing, &c., R. Bird, London.
13,567. Electrical Firing Mechanism, A. M. Clark.—(*P. Oriolle, France.*)
13,568. Button-hole Scissors, J. G. Tongue.—(*F Blasberg, Leipzig.*)

7th October, 1887.

13,569. Hook for Securing Scarves, &c., H. Hartley, Leeds.
13,570. Steel Forgings, T. R. Weston, London.
13,571. Measuring Liquids, E. Latham, Liverpool.
13,572. Drying Small Coal, &c., J. A. Yeadon and R. Middleton, Leeds.
13,573. Mechanism for Opening Curtains, &c., J. Wilkinson, London.
13,574. Destroying Black Beetles, &c., L. Ledain, Paris.
13,575. Measures, J. Holmes, Keighley.
13,576. Fastenings for Window Sashes, W. H. S Aubin, Bloxwich.
13,577. Decorating Pottery-ware, J. Emery and H. Lockett, Longport.
13,578. Milling and Profiling Machines, G. Richards, Manchester.
13,579. Mechanical Toys, J. Sample and J. Grantham, Newcastle-on-Tyne.
13,580. Propellers for Ships, &c., W. Welch, Portsmouth.
13,581. Musical Instruments, W. H. Brazil, Deansgate.
13,582. Domestic Oil Lamps, W. Devoll, Erdington.
13,583. Cap of Safety Pins, S. Bagnall, Birmingham.
13,584. Bobbin for Lace Machines, J. Jardine, Nottingham.
13,585. Back Pressure Valves for Footballs, J. Hebblewaite, Manchester.
13,586. Cartridges for Blasting, H. de Mosenthal, London.
13,587. Programmes, &c., M. H. Schönstadt, Liverpool.
13,588. Extinguishing Fire in Theatres, &c., L. A. Walker, Manchester.
13,589. Portable Hand Pumps, S. B. Wilkins, Edinburgh.
13,590. Construction of Wheels, G. W. Moon, London.
13,591. Blast Pipes, H. Appleby, London.
13,592. Game, B. Juraj, London.
13,593. Rendering Articles Water-repellent, C. B. Warner, London.
13,594. Supporting Plates, &c., E. Leak, London.
13,595. Surgical Operating Tables, W. Rose and K. H. Monk, London.
13,596. Oil Lamps, A. H. Griffiths and A. J. Johnson, London.
13,597. Full Cased, &c., Hames, J. Parkes and F. Gnosill, London.
13,598. Coal Cutting Machine, R. S. Moore, London.
13,599. Tobacco Pipes, R. R. Russell, Glasgow.
13,600. Depositing Letters, De F. Pennefather, London.
13,601. Automatic Coin-worked Machines. &c., J. H. Davies and A. Thompson, London.
13,602. Signalling on Railways, E. P. Delevante, London.
13,603. Bearings for Wheels of Carts, S. Copeland, London.
13,604. Automatic Machines, H. A. Burt, London.
13,605. Automatic Dynamo-metric Machine, J. Conte, London.
13,606. Match-boxes, D. Oppenheimer, London.
13,607. Cutting Loaf Sugar, T. Webb, London.
13,608. Cycles, W. G. Gibbins, London.
13,609. Sewing Machine Attachment, H. J. Haddan.—(*J. P. Rey, France.*)
13,610. Electrical Keys for Firing Guns, J. L. Clark, London.
13,611. Tandem Tricycles, T. R. Marriott and F. Cooper, London.
13,612. Sewing Machines, F. N. Cookson, London.
13,613. Piston and Plunger Pumps, H. H. Lake.—(*A. Riedler, Germany.*)
13,614. Toe-caps for Boots and Shoes, C. Laight and W. Unitt, Birmingham.
13,615. Rigging Woollen Fabrics, H. H. Lake.—(*S. Scholfield, United States.*)

8th October, 1887

13,616. Rotary Printing Machines, J. M. Black, London.
13,617. Cricket and Football Spike, W. R. Maud, Pontefract.
13,618. Sewing Machines, A. Gass, Belfast.
13,619. Perambulators, E. Borsey, Manchester.
13,620. Advertising, G. Fisher, Newcastle-upon-Tyne.
13,621. Precipitating Grain, &c., W. Adair and W. J. Radford, Liverpool.
13,622. Stamping, &c., Apparatus, &c., E. Daguin, London.
13,623. Sight Feed Lubricators, W. James and G. Crowe, Chester.
13,624. Affixing Bands to Umbrellas, &c., S. Simon, London.
13,625. Machine Comb Circles, J. Dunlop, J. Dunlop, and A. Smith, Bradford.
13,626. Teaching of Music, A. Adamson, Glasgow.
13,627. Illuminating Gas, Ammonia, &c., H. Kenyon, Manchester.
13,628. Railway Chairs, J. Chambers and J. Colby, Lowestoft.
13,629. Holders for Writing Styles, M. Myers and E. Hunt, Birmingham.
13,630. Automatic Extinguisher Lamp Burners, I. Werber, London.
13,631. Self-acting Guides for Bicycles, J. T. Tilby, London.
13,632. Appliances for Railway Buffering, E. C. Ibbotson, Sheffield.
13,633. Mules for Spinning, H. Ainsworth, London.
13,634. Syphon Flushing Cistern, W. H. Day and G. Dimmer, West Cowes.
13,635. Fastening for Railway Chairs, J. Chambers and J. Colby, Lowestoft.
13,636. Cutting the Hair of Horses, W. H. Burman, Birmingham.
13,637. Telephonic Apparatus, H. F. Jackson and D. Sinclair, Glasgow.
13,638. Catch Indicator for Net Fishing, C. Colwell, Southdown.
13,639. Automatically Feeding Horses, A. Samson, London.
13,640. Looms, &c., T. Cotton and W. H. Thompson, Halifax.
13,641. Voltaic Batteries, T. and H. V. Coad, London.
13,642. Straw Pressing Machine, E. Scott, Lincoln.
13,643. Lump Sugar, W. Hoskin, Halifax.
13,644. Automatic Grain-weighing Apparatus, J. L. Penney, Manchester.
13,645. Weaving, J. Edelston, Manchester.
13,646. Drawing Tubes, W. Orr and P. S. Brown, Glasgow.
13,647. Separating Chlorine from Gas Mixtures, C. Heinzerling, Berlin.
13,648. Decomposing Chlorides of Metals, C. Heinzerling, Berlin.
13,649. Controlling the Discharge of Water, C. L. Braithwaite, jun., and I. Braithwaithe, Liverpool.
13,650. Antifriction Roadways, S. J. Eslick, Liverpool.
13,651. Bedstead Furniture, W. Ray, J. Miles, J. B. Brough, Liverpool.
13,652. Heel Plates, R. Bradshaw, Manchester.
13,653. Stationary Steam Engines, J. A. and A. H. Stott, jun., London.
13,654. Height Measuring Apparatus, H. B. Barkham, London.
13,655. Oil Lamps, H. A. Kent, London.
13,656. Plates, W. Rickwood, London.
13,657. Angle Plates, W. Ambler and J. Hardcastle, London.
13,658. Recording Games, F. Baxter, London.
13,659. Magazine Fire-arms, P. T. Godsal, London.
13,660. Colouring Matters, S. E. Gunyon.—(*P. Tournayre, France.*)
13,661. Chin Rests for Violins, R. Moore and C. W. Townley, London.
13,662. Collapsible Boxes, &c., W. F. Hunt, London.
13,663. Compensating Balance Wheel for Watches, E. Golay, London.
13,664. Oil Lamps, H. Grieger, London.
13,665. Lamp-burners, H. Gillette and W. H. O'Brien, London.
13,666. Affixing Labels to Tins, &c., H. H. Wills, London.
13,667. Refrigerating Apparatus, L. Perkins, London.
13,668. Piston Packing, I. B. Harris, London.
13,669. Rock Tunnelling, H. N. Penrice, London.
13,670. Delivery Nozzles of Taps, &c., H. C. Ash, London.
13,671. Substitute for Gutta-percha, H. Siebert, London.

10*th October*, 1887.

13,672. Mineral Water Bottle, W. Fraser, London.
13,673. Shirts, J. H. Knight, Liverpool.
13,674. Endorsing Stamps, H. C. Gover, London.
13,675. Door Checks and Closers, T. Potter, Manchester.
13,676. Flushing Cisterns, H. Harris, Ryde.
13,677. Safety Guards for Engines, G. E. Asbury, Birmingham.
13,678. Turbine Ventilator, F. Pelzer, London.
13,679. Penholder and Blotter, S. H. Crocker, London.
13,680. Roofs, J. Season, Leeds.
13,681. Protecting Marine Propeller Shafts from being Clogged, R. Armstrong and E. J. Caiger, London.
13,682. Rotary Slides and Railways, W. H. Duncan, Coalbrookdale.
13,683. Corking Bottles, J. Packham, Croydon.
13,684. Securing Newspapers, &c., J. Maguire, Dublin.
13,685. Axles, J. Grice, Birmingham.
13,686. Checking the Shuttles in Looms for Weaving, R. Boothroyd, G. Thornton, and J. Haigh, Halifax.
13,687. Machines for Feeding Wool, &c., J. E. Shaw and J. Davidson, Halifax.
13,688. Kilns for Burning Bricks, &c., H. Gross, Bradford.
13,689. Feed Knives of Combing Machines, J. W. Firth and M. Shackleton, Bradford.
13,690. Counters for Mules, D. Orme, Manchester.
13,691. Mechanical Toy representing a Fly, J. B. Robinson, London.
13,692. Extinction of Fires in Theatres, &c., J. Miller, Liverpool.
13,693. Producing Ozone, G. Trier.—(*C. R. Poulsen, Denmark.*)
13,694. Surgical Operating Tables, K. H. Monk and S. Roskilly, London.
13,695. Obtaining Nitrites, &c., C. Huggenberg, London.
13,696. Paddle Wheels for Propelling Vessels, C. Tapsfield, London.
13,697. Horizontal Feathering Paddle Wheel, A. H. Brown, London.
13,698. Pumps, E. S. Baldwin.—(*W. Angus, New Zealand.*)
13,699. Cleansing Wool, I. Singer and M. W. Judell, London.
13,700. Westinghouse Brake, G. Massey, London.
13,701. Automatic Indicator for Ships, W. Brewster and G. H. Tulloh, London.
13,702. Convertible Stand, &c., F. S. Weatherley, London.
13,703. Micrometer Gauge, D. G. Brown and W. Lancaster, London.
13,704. Brush and Reservoir, &c., W. England, London.
13,705. Dowel Pins, C. F. Stewart, Canada.
13,706. Water Valves, H. Walker and W. C. Riddick, London.
13,707. Making-up Reversible Cuffs, M. Wilson, London.
13,708. Combing Machines, J. C. Mewburn.—(*P. Lamourette and A. Morand, France.*)
13,709. Mechanical Wire Compensator, R. S. Bozon, London.
13,710. Book Holder, W. K. Graham.—(*H. O. Brown, New Zealand.*)
13,711. Governors for Steam Engines, E. D. Skelton, London.
13,712. Cigarettes, J. Needham, London.
13,713. Raising Window Sashes, M. Morgan and J. B. White, London.
13,714. Pulling Up Venetian Blinds, J. P. Robertson, London.
13,715. Steam Engines, W. H. Winnall and R. Price, London.
13,716. Manufacture of Hats, G. F. Redfern.—(*D. Willems, Belgium.*)
13,717. Cigar, &c., Tubes, E. W. Stead, London.
13,718. Advertisement, &c., Tablets, D. Harper, London.
13,719. Machines for Cleaning Land, &c., S. J. Coole, London.
13,720. Effecting Electrical Measurements, &c., A. de Khotinsky, London.
13,721. Rope Driving Gear, W. J. Prismall, London.
13,722. Electrical Secondary Batteries, C. E. Ponder, J. Macgregor, and P. Harris, London.
13,723. Decorating Glass, C. Amand-Durand and R. P. Engelmann, London.
13,724. Ejecting Liquid on Receipt of a Coin, J. M. O'Kelly, London.
13,725. Setting Photographic Emulsions, J. W. T. Cadett, Ashstead.
13,726. Infusions, C. Jones, London.
13,727. Production of Yarn from Hair, J. J. Delmar, London.
13,728. Catmeters, J. Banks, London.

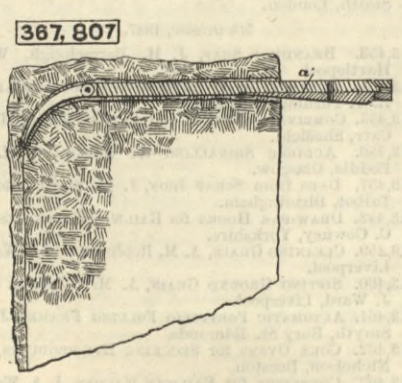
SELECTED AMERICAN PATENTS.

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

367,807. Miner's Tool for Breaking Down Coal, *J. Hagg, Troutville, Pa.—Filed March 8th*, 1887.

Claim.—(1) The herein-described device for breaking down drilled and undermined coal, which device consists of the staff or shaft of suitable length, the curved and tapered end section pivotted to one end of the staff, and the wedge section pivotted upon one side of

367,807

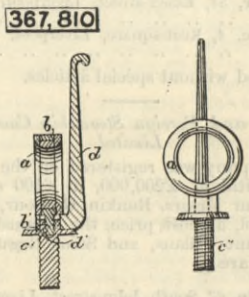


the staff near the other end, substantially as specified. (2) The herein-described coal mining tool or device, composed of the staff provided with the head a, and inwardly bevelled inclined shoulder a^2, the curved end section having its concavity on the same side of the staff as said shoulder, pivotted within the bifurcated end of the staff, tapering thence to its point and provided with a lateral chisel edge at said point, and the wedge portion pivotted on the staff in the depressed or cutaway portion a^1, and having its inner end bevelled and inclined to engage with the shoulder a^2, substantially as specified.

367,810. Check Hook, *J. B. Higgins, Boston, Mass.—Filed October 18th*, 1886.

Claim.—(1) In a check-rein holder, the ring a, in combination with the substantially vertical rod or post d, arranged on the rear and entirely outside of the said ring a, as and for the purpose set forth. (2) In a check-rein holder, the split ring b, having the split screw-threaded shank b^1 and the ring a, made adjustable within said split ring, in combination with

367,810

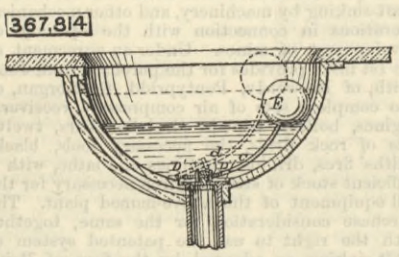


the rod or post d, arranged at the rear of said ring a, as and for the purpose set forth. (3) In a rein-holder, the ring a and the split ring b, with its split screw-threaded shank b^1, arranged as described, in combination with the socket c, having flange c^1 and screw-threaded projection c^{11}, and the post or rod d, with its perforated base d^1, substantially as and for the purpose set forth.

367,814. Wash-basin Stopper, *F. R. Johnson, Brooklyn, N.Y.—Filed November 13th*, 1886.

Claim.—(1) In stationary hand wash basins, the combination of the float E, lever D^1 D D and stopper C, the stopper being loosely suspended upon the lever at the movable extremity of the short arm, and the long arm D^1 D D, having for its fulcrum simple contact upon the interior surface of the basin, in the manner set forth, whereby in use the stopper is gradually raised and lowered by the float lever, and whereby the whole device can be rotated in a horizontal circle within the

367,814

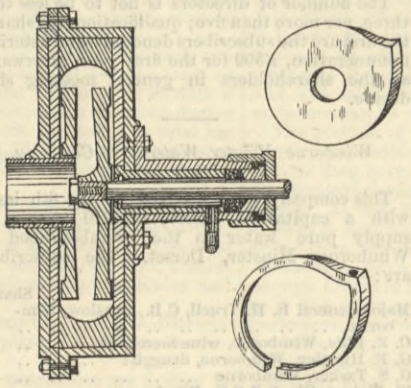


basin and be freely detached therefrom, substantially as and for the purposes described. (2) In stationary hand wash basins, the combination of the float E, lever D^1 D D, stopper C, and adjusting nuts d d, the stopper being loosely suspended upon the lever at the movable extremity of its short arm, and the long arm D^1 D D, having for its fulcrum simple contact upon the interior surface of the basin, substantially in the manner and for the purposes set forth.

367,911. Centrifugal Pump, *E. J. Hawley, Manchester, Vt.—Filed March 23rd*, 1887.

Claim.—(1) In a centrifugal pump, the combination, with the casing, the removable cap-plate, and a removable annular lining, of side linings, consisting of two plates of hard metal, one of which is placed loosely on each side of the annular lining, and all of said linings being held in place by the cap-plate of the

367,911

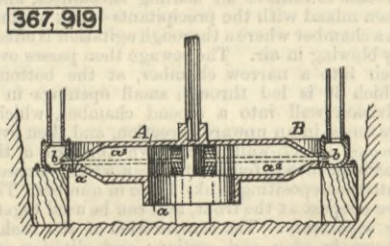


casing. (2) In a centrifugal pump having a recessed cap-plate, the combination, with the casing, the removable recessed cap-plate, and a removable annular concave-faced lining, of side linings, consisting of two plates of hard metal, one of which is placed loosely in the casing on each side of the annular lining, and all of said linings being held in place by the cap-plate of the casing, all as described and for the purpose set forth.

367,919. Centrifugal Pump, *I. P. Lambing, Ione, Cal.—Filed February 28th*, 1887.

Claim.—In a centrifugal pump, a hollow rotating driver having a central suction aperture and a continuous peripheral slot, and provided with wedge-shaped radial partitions or diaphragms of different length and alternating long and short, whereby radial chambers with tapering outer ends are formed, in combination with a fixed receiving casing encircling the driver and having a continuous receiving aperture or slot in its side opposing the peripheral slot of the

367,919

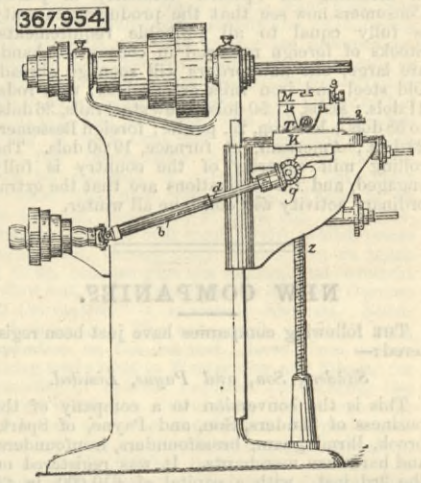


driver. In a centrifugal pump, the rotating hollow driver A, having the central suction aperture a, the bevelled rim with the continuous peripheral discharge slot a^1, and radial partitions a^2 and a^3, wedge-shaped and alternating long and short, whereby radial chambers are formed with tapering outlets, in combination with a fixed annular receiving casing B encircling the driver without touching it, and having on its inner surface a continuous receiving slot b opposing the slot of the driver, said receiving slot being of an inwardly-tapering or funnel shape, all arranged and operating substantially as herein described.

367,954. Milling Machine, *A. H. Brainard, Hyde Park, Mass.—Filed April 23rd*, 1887.

Claim.—In a milling machine, the combination, with the telescopic arbor of a horizontal arbor journalled in the bed and geared with and driven by the telescopic arbor, the table feeding screw provided with gearing through which it may be driven, and intermediate gearing connected with the gears on said screw and horizontal arbor and adapted to transmit the motion of the arbor to the screw, substantially as specified. In a milling machine, the combination of telescopic arbor b d, driven by connection of a gimbal or other universal joint, arbor g, geared with and driven by said telescopic arbor, endless screw p, secured on said arbor g, tangent wheel q, mounted on arbor s and driven by screw p, gear w, secured on and driven by arbor s, gears x, arranged on opposite sides of gear w and driven thereby, screw T, arranged in the axis of gears x, threaded in the turntable, and shouldered in the worktable, and clutch z, interlocked to revolve with said screw and formed to be interlocked with gears x, and provided with a shipping mechanism by which it may at will be interlocked with or liberated from either of said gears, substantially as specified.

367,954

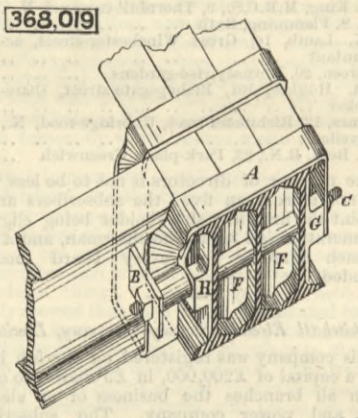


The combination, with clutch z and lever 2, pivotted at one side thereof and pivotally connected therewith, and formed with opening 6, having inclined ends, as shown, of conical-ended pin 7, provided with an elevating spring and an automatic depressing device, substantially as specified. The combination of clutch z, lever 2, pin 7, with its elevating spring, adjustable block 9, and locking pin 12, provided with a depressing spring, all constructed and combined to operate substantially as specified. The combination, with turntable L, interlocked with and supporting worktable M and formed with a concentric pivotal hub, of bed K, formed with a concentric recess to receive said hub, and the arc-like open slots l, having a radius point or centre in common with but a radius greater than said hub, and locking bolts k, seated in said slots and threaded in the turntable, whereby the latter may be locked in position by said bolts arranged outside the periphery and on opposite sides of said pivotal hub, substantially as specified.

368,019. Beam Connection, *J. F. Sims and W. B. Morris, San Francisco, Cal.—Filed August 26th*, 1886.

Claim.—(1) In a beam connection, the combination of the clamp B with the bolts C C^1, packing pieces G G^1 H H^1, and the diaphragms F F F F, all arranged and operating substantially as described. (2) In a beam connection, the stirrup A, secured to the girder and supporting the tail or header beam, and the

368,019

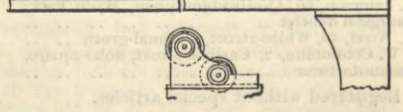


clamp B, passing through the end of the said beam, in combination with the bolts C C^1, securing the ends of the stirrup to the girder, passing through said girder and connected with the clamp, substantially as and for the purpose herein described. (3) In a beam connection, the combination of the stirrup A, the clamp B, tie-bolts C C^1, the packing pieces G G^1 H H^1, and the diaphragms F F F F, all arranged and operating substantially as and for the purpose herein described.

368,021. Lathe, *C. Smith, Belleville, N.J. — Filed April 21st*, 1887.

Claim.—(1) In a lathe, the live head provided with the spindles F G, the former being on a higher elevation than the latter, substantially as set forth. (2) In a lathe, the live head provided with the spindles F G, one being on a higher plane than the other, combined with the tail stock having spindles corresponding in

368,021



position with those in the live head, substantially as set forth. (3) In a lathe, the live head provided with spindles F G, one being on a higher plane than and to the rear of the other, and connected by gearing which operates to increase the power and reduce the speed of the higher spindle, substantially as set forth. (4) In a lathe, the live head provided with spindles F G, one being on a higher plane than and to the rear of the other, and the two being connected by gearing, substantially as set forth.