INTERNATIONAL RAILWAY CONGRESS AT BRUSSELS.

No. II.

THE first section of the Congress, dealing with "permanent way and works," had before it two questions, the first of which was, "Types of way best suited to the various lines according to their nature and importance." This was introduced by a report by M. Lebon, manager of the Grand Central Belge, who described the various systems of permanent way, including metal sleepers, observing that timber longitudinal way was now definitely abandoned, and that metallic longitudinal way had partisans only in Germany and Austria. M. Vogelaere, inspector-general of the Belgian State Railways, agreed in the rejection of a metallic longitudinal system, and declared that metal sleepers behaved better as regards stability, though sufficient time had not elapsed to decide about their durability. No sleeper should weigh less than 70 kilogs., or $1\frac{3}{8}$ cwt., the weight of an oak sleeper, so that the first cost would be greater for iron than for timber. Gravel ballast would be required, as the sulphur in ashes acted on the metal. Mr. Bradford Leslie, agent for the East Indian Railway, put in a special note on the advantages of a way laid with double-headed rails supported by the jaws—one fixed and the other movable—of flat cast iron sleepers. The breakage on the East Indian Railway, with 14 tons on each pair of driving wheels, was only 1 per cent. per annum after the first laying. M. Huberti, Professor at the Brussels University, considered that there was not sufficient experience of the metal sleeper to warrant the statement that it is capable of competing with timber. M. Stévart, Professor of Railway Engineering at the Liége School of Mines, considered the metal sleeper capable of holding its own if sufficiently strong and heavy. Ultimately it was decided that, from a technical standpoint, metal sleepers can compete with those of timber, both for light and heavy traffic, while, as regards financial considerations, competition was also possible. The second question—as to practical methods for comparing the cost of construction and working of various projects for the same line, differing both in plan and section—formed the subject of a long and exhaustive paper by M. Gérard, engineer on the Belgian State Railways, and also of a report by the First Section, whose conclusions were adopted by the Congress to the following effect:—Rapid methods only afford practically comparable results when applied to each particular case, taking local circumstances into consideration. No general formula, however complicated, can permit of comparing with sufficient accuracy several complete projects of the same railway; and this comparison requires a knowledge of the precise situation of each curve and gradient. The use of steel rails and the great progress made in the power and flexibility of motors permit of laying railways in mountainous districts much more economically than heretofore, whilst allowing greater latitude in the matter of curves and gradients.

The second section—"Traction and Rolling Stock"—dealt with questions 3 to 6 inclusive. In connection with "principles to be observed in the construction of rolling stock with a view to facilitate exchange," M. Hubert, chief engineer of the Belgian State Railway Administration, sent in a paper recording what had hitherto been done in this direction, and giving, as an appendix, the final protocol of the Berne Conference in 1882 on the technical unity of railways. The Section expressed a wish to see all the States represented at the next Berne Conference, which is to confirm the resolutions passed at the preceding one, after they have been submitted to the various Governments. This was adopted by the Congress, who, however, rejected a proposition by Herr Von Leber, the Austrian delegate, to limit the height of rail to 13 centimetres, or 5in., and the weight on each axle to 14 tons.

A lively discussion followed, in connection with the fourth question, "expense of working and reduction of expense," as to whether a locomotive should be entrusted to one driver only or to two alternately. M. Gérard said it would be as bad as bigamy to give an engine to two drivers; but M. Banderali, of the French Northern Railway, observed that perhaps, on the contrary, the locomotive would be better taken care of by two than by one. Ultimately this opinion prevailed.

The fifth question, as to safety in working, was divided into three parts. Part A, relating to the stoppage of trains, formed the subject of a paper by Professor Hubert on "Continuous Brakes," in which he observed that the question of continuity of brakes was settled for passenger trains, and was in course of settlement for goods trains, though opinions varied greatly as to the best brake. After quoting the conditions stated in the Board of Trade circular, the author gave it as his opinion that, in appreciating a brake, the following points should be considered:—As regards safety: Energy, rapidity of action, and automaticity; and as regards exigencies of working: first cost, expense of maintenance, and possibility of intercoupling stock of different companies. In the sectional discussion, the principle of automaticity was contested, it being contended that, if this were established, invention would only be continued in that particular direction. This view of the case prevailed, and was ultimately endorsed by the whole Congress, which passed a resolution to the following effect:—"Considering that continuous brakes have lately rendered incontestable service in railway working, the Congress recommends their use whenever compatible with the conditions of working."

As regards the safety of passengers—section B—M. Degraux, engineer of the Belgian State Railway, sent in a paper describing the construction of carriages and means of intercommunication; and the Congress merely expressed the opinion that it was desirable to establish effective means of communication between passengers and railway servants, at any rate on through trains. Respecting safety to railway servants in shunting and coupling, M. Lapierre, Inspector-General of the Belgian State Railways, contributed a paper giving the results arrived at by the Special Commission on the subject, appointed the previous year by the Belgian Government, and reproducing the regulations laid down by the Commission. It appears that the following system, now made obligatory on the Belgian State lines, had long been in use at the Liége-Guillemins station. When a train of wagons has to be broken up into its component parts, for one or more wagons to run on to the different sidings, a man unscrews the couplings and unhitches the safety chains while the wagons are being marked with the siding on to which they are to be run. He has then only to follow, upon the 6-foot, the train in motion, and unhitch the draw-hook with a staff, an operation which he is able to perform in the dark after a little practice. The members of the section were generally in favour of the principle of continuous traction—that is to say, a continuous drawbar—for passenger trains. Incidentally, Herr H. Dietler, general manager of the St. Gothard Railway, gave some interesting information as to that line. The resistances in the helicoidal tunnels were found to be much less than anticipated, as the train speed is higher than that for which the calculations were made.

The sixth question of the programme, relating to the applications of electricity to railway working, formed the subject of a long paper by M. Weissenbruch, engineer at the Belgian Ministry of Railways, Posts, and Telegraphs, giving an account of what has already been accomplished in the transmission of signals and of mechanical motions, including intercommunication and signalling from and to trains in motion, the electrical illumination and warming of carriages, and electrical traction. The author proposed that the Congress should assert that electrical methods are sufficiently certain to be employed in railway works, that magneto-electric machines should be preferred to batteries, and that a continuous current should constantly traverse every line, so as to give immediate warning of any interruption. As the Congress was already surcharged with work, a special meeting of the second and third sections was arranged to take this proposition into consideration, when, leaving the matter over to a future Congress, the following platitude was put on record:—The second and third sections combined acknowledge that great progress has been made in the use of electricity applied to railway working; and it is probable that a further degree of progress will considerably increase the safety. The question whether electrical or mechanical appliances should be preferred is one of space, distance, climate, &c., which can only be solved by a comparative investigation in each case.

The third section, "Working," had three questions to consider, of which the first was No. 7, dealing with arrangements most calculated to insure the safety, rapidity, and comfort of passengers; communication between railway servants on the track and those on trains and in stations; the best application of the block system; safety at stations, junctions, level crossings, and turntables, together with the influence of the block and interlocking systems on the traffic. This formed the subject of a paper by M. Charles Ramaeckers, general manager of way and works, and M. Is. Blancquaert, general manager of traction

FIG 1

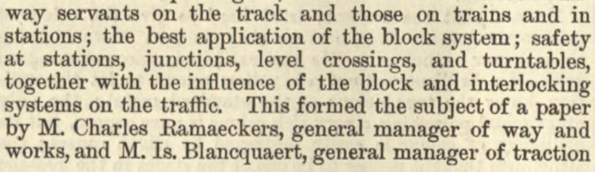


FIG 2

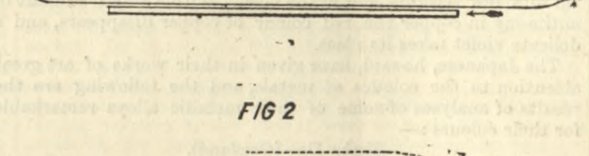


FIG 3

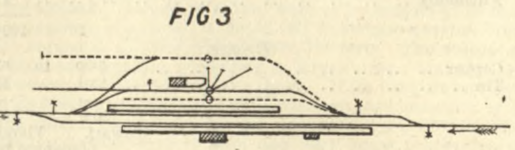
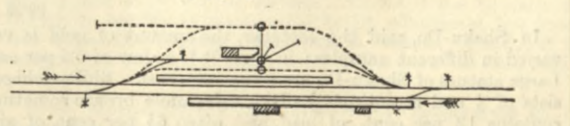


FIG 4



and rolling stock, both on the Belgian State Railways. The section would not express any opinion as to the best type of carriage, but pointed out the conditions to be observed in heating and lighting; recognised the fact that most railway administrations had adopted the English principle of absolute block, recording the conditions which it should satisfy; and expressed the opinion that the block system had had the effect of increasing the traffic on lines to which it was applied. It also stated that the use of interlocking arrangements at stations had increased the safety and also the capacity of the service, while, however, accidents could never be entirely suppressed.

The eighth question, as to the principles to be observed in the establishment of stations of various degrees of importance, formed the subject of a report by Messieurs Ramaeckers and Blancquaert, describing their arrangement on the Belgian State Railways, and also of a special note by M. Drouin, inspector-general of the Alta Beira Railway, illustrated by the accompanying diagrams. The usual arrangement of stations on single lines of slight traffic—Fig. 1—has the disadvantages of considerably lengthening the siding which permits of trains crossing; of extending the duration of time necessary for shunting the up trains, thus rendering it necessary to cut in two trains that stop any length of time at the station, in order to permit passengers to pass; of delaying the shunting operations of a train until its passengers have left the station; of obliging down trains to shunt on the goods siding which joins the main line where the passenger carriages are standing, and which are thus liable to collision at any angle from a wagon to which too great an impulse may have been given; of interfering with the luggage and parcels arrangements of down trains; of preventing the possibility of up and down trains which cross shunting at the same time, and of obliging up trains to deposit wagons to be left on the siding intended for those to be taken. Besides, this arrangement admits of no extension or improvement except a new goods siding, connected at both ends by points, as in Fig. 2, while considerably reducing the length *a b* of siding. On the other hand, if the arrangement shown by Fig. 3 be adopted, which puts the goods and passenger platforms on opposite sides, all the buildings are concentrated, permitting of equal shunting facility for up and down trains, while rendering the supervision of the whole station very convenient. Fig. 3 also lends itself admirably to a doubling of the line, as shown by Fig 4, while suppressing the facing points; whereas the types shown in Figs. 1 and 2 do not admit of it without very defective arrangements. M. Drouin concluded his note by insisting that the main lines should enter a station so that facing points should always be passed without deviation, as shown in Types 2 and 3, and that sidings should be arranged in a fan-shaped figure, radiating from the turntable of the main goods siding, thus effecting great economy of labour in the sorting of wagons.

Question 9—stations and pieces of line common to more than one company—formed the subject of a paper by M. Matriot, traffic manager of the French Eastern Railway, and of a note by M. Drouin, offering suggestions for the equitable distribution of expenses. The Congress pronounced in favour of common stations for large and small lines, and of each common station being in the hands of one direction.

The fourth section, "general questions," dealt chiefly with secondary railways, a subject of great interest to Belgium at the present time, as a national society, patronised by the Government, has been formed for supplying means of communication to even the most unimportant localities. In connection with this subject, a resolution was passed to the effect that secondary lines should be regarded as affluents of the principal lines, and receive their support. The question of Sunday rest was also debated at length, and led to a resolution in favour of the extension of periodical rest, coinciding as far as possible with Sundays and holidays.

The last and twelfth question of the programme was that of an understanding to be arrived at by the various railway administrations for adopting a uniform classification of receipts and payments, and of a type of report permitting of useful comparisons between the results obtained. This was introduced by a paper by M. Kesteloot, Head of Department at the Ministry of Railways, Posts, and Telegraphs, who advocated the establishment of an international bureau for railway statistics, similar to that of the Postal Union and the International Telegraph Union. At the closing *séance*, M. Pineiro, the Brazil delegate, proposed that a new Congress should be appointed for taking this subject into consideration; and ultimately the Congress passed the following resolution:—"The organising committee of the Congress, assisted by its Bureau, is charged with constituting a new Congress, and with submitting to it the bases of an international scientific association, with the object of promoting the technical progress of railways by conferences, publications, and other means, especially by facilitating the relations between railway administrations. Provisionally it is charged with filling the office of technical statistical bureau; and the next Congress is charged with taking measures for forming an international statistical bureau at Brussels."

The engine illustrated at the top of page 164 is a passenger locomotive, with four-coupled wheels 6ft. 7in. diameter; the cylinders are 17in. diameter and 22in. stroke; there are 208 tubes, and the weight of the engine full is 35 tons.

The second is an express engine, with four-coupled wheels 6ft. 7in. diameter; the cylinders, $17\frac{1}{2}$in. diameter, with a stroke of 24in.; there are 225 tubes, and the total weight of the engine in running order is 40 tons. The principal dimensions of both engines are given in metres in the engraving.

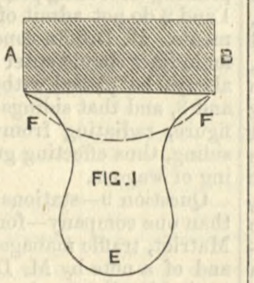
THE ROYAL INSTITUTION.

CAPILLARY ATTRACTION.

ON Friday, January 29th last, Professor Sir William Thomson lectured at the Royal Institution on "Capillary Attraction." Dr. William Huggins, F.R.S., presided.

The speaker said that it had been known from time immemorial that heaviness depends upon mutual attraction between different portions of matter, but that before Newton's discovery of universal gravitation it was not suspected that heaviness is due to attraction at a distance between two portions of matter, which act upon each other in obedience to the law of the pull varying as the square of the distance. Cavendish proved experimentally that this law holds good with two small portions of matter not far apart, but men had been willing to admit infractions of the law at still smaller distances; his question that evening was whether the law held good at very small distances, down, say, to the hundred-millionth of a centimetre. Those who admitted the infraction of the law at very small distances were not ready to admit its infraction at very great distances. If it were found that it was not necessary to explain the atomic and molecular phenomena of cohesion and capillary attraction by the abrogation of Newton's law of gravitation when small distances were concerned, then they were not forced to admit such deviation. Capillary attraction was so named because it was first recognised in hair-like tubes, which were not indispensable for the exhibition of the fundamental phenomena. Quincke concluded that molecular attraction becomes sensible at distances of about fifty micro-millimetres, and his conclusion is confirmed by the discovery of Reinold and Rücker that the black film, always formed before a soap-bubble breaks, has a uniform or nearly uniform thickness of about eleven or twelve micro-millimetres; the black film has an abrupt commencement, and somewhat permanent stability, which evidently depends upon molecular heterogeneousness. It is conceivable, he argued, that gravity may be the force by which the phenomena of cohesion, consequently of capillary attraction, are produced; all that is necessary is, putting aside for the moment ideas about the motion of atoms, that the atoms should have sufficient density to increase the force of gravity to any desired extent. It is a question of intensity of density. He, Sir William Thomson, had put forth this idea nineteen years ago, but it attracted little attention at the time, nor did he think that it deserved to do so, for molecular motions must be taken into consideration. He then called attention to the result of some mathematical investigations of the attraction exerted by drops of water when free from the action of gravitation, to the effect that he had found $\frac{1}{16}$ or $\frac{1}{13}$ of a centimetre-gramme of work per square centimetre of diminution of surface. This is precisely the result which would have been obtained if the water had been absolutely deprived of the attractive force between water and water, and its whole surface had been coated over with an infinitely thin contractile film possessing a uniform contractile force of $\frac{1}{13}$ of a gramme weight per lineal centimetre.

He proceeded to show a few experiments, including one in which a large flat ring of wood, A B, like that of a sieve, had a piece of thin sheet india-rubber stretched over its lower orifice; water was then poured in, and the imitation drop of liquid, 2ft. or 3ft. long, E, was formed; he showed that this drop had two positions of stability, for by pressing it upwards with his hands it would also rest steadily in the position denoted by the dotted line F F. In water drops, he said, there is no actual external film, but the surface tension acts in the same way as if there were one.



In relation to the surface tension of fluids, he said that his brother, Professor James Thomson, had been the first to explain the phenomenon of the "tears of wine," to which Solomon perhaps alluded when he said that wine "moveth itself aright," which in the new version is altered to "goeth down smoothly." Aqueous liquids containing 20 per cent. of alcohol show the effect best. Stronger and weaker mixtures do not show it so well. A large sheet of glass in an inclined position was painted across horizontally with a 20 per cent. mixture of coloured alcohol and water as a broad liquid band, and the tears on a large scale were seen running from the top of the band downwards, the speaker remarking, "Pull alcohol—pull water." He said that the vapour of alcohol passes off quicker than the vapour of water; the relative volume of water in the liquid is thereby increased, and its surface tension likewise, the result being that it pulls harder at the liquid below, and draws it up until equilibrium is restored.

In another experiment he showed that a film of water would recede upon the approach of a camel's hair brush charged with ether, the ether vapour driving the water with some force before it.

He said that diffusion was the result of negative surface tension, and that as great a negative pressure had been observed as 100 atmospheres, or 1 ton per 10 square centimetres. When the experiments were finished, the time allotted for Royal Institution lectures had expired.

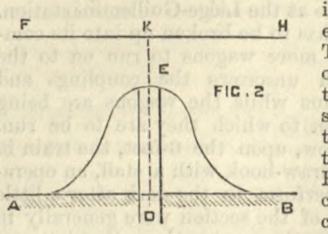
VOLCANIC ACTION IN BRITAIN.

On Saturday, January 30th, Mr. Archibald Geikie, F.R.S., Director-General of the Geological Survey of the United Kingdom, delivered the first of four lectures on "The History of Volcanic Action in the British Isles." He said that the lava streams and ashes the volcanoes have left behind are of special value in furnishing geologists with data for their conclusions as to the periods to which the volcanoes belonged. Evidence exists of volcanic eruptions in very early times, then a long lull, and afterwards a great outbreak, as if the earth had been slowly cooling, and a greater outbreak produced by the vents breaking through a thicker crust. Geological evidence tends to prove that once there was much more land than at present in northern Europe; that land may have been as large as Spain, and by its denudation about three miles in depth of our geological strata have been built up; perhaps when some of that ancient land was washed down, other land took its place by upheavals.

The Cambrian rocks near St. Davids, in Pembrokeshire, furnish the earliest known traces of volcanic action; a shallow sea then stretched across the northern part of Europe, and washed the shores of the Archæan land already mentioned, consequently volcanic ashes and lavas are found mixed with the muds and sands of the Cambrian sea. A volcanic series 1800ft. thick is actually visible. The lavas greatly, but not quite, resemble those of recent volcanoes, so much so that without evidence no one would have believed that they belonged to so ancient a period as the Cambrian, in which the volcanic action did not cease suddenly, but died out gradually. When the Silurian period was afterwards reached, there was a great increase in volcanic activity in the shallow sea which washed the shores of the old Archæan land to the north; low forms of vegetable life were then prevalent, also low forms of animal life, such as scorpions and insects; in the Silurian period the first fishes made their appearance. The extinct volcanoes of the Westmoreland lake district, of North Wales, and of the south-east of Ireland, belong to the Silurian period, and in Wales there were volcanoes enough to eject as much materials as by scores of volcanoes such as Vesuvius; the ashes from them fell at different times upon the sea bed. There is no evidence of anything in Wales but submarine eruptions, and the present mountains in North Wales now bear no resemblance to their ancient form, they having been denuded and worn away, leaving only some of the harder portions and volcanic vents with their tops shaved off.

In his second letter, delivered on February 6th, Professor Geikie remarked that prodigious terrestrial disturbances took place towards the close of the Silurian period; the bottom of the ancient shallow sea was then first raised up into islands and archipelagoes. The volcanic zones in general took a north-west south-east direction from Ireland, through Scotland to Norway, Sweden and Scandinavia. The lakes of the lower old red sandstone also made their appearance, chiefly in Scotland, but there was a large one over the whole of the eastern portion of Wales. One very large lake stretched across Scotland from the Edinburgh district, into what is now the north-eastern part of Ireland, and in the part of this lake in the east of Scotland there were abundance of volcanic vents.

In his third lecture, delivered February 13th, Professor Geikie dealt with volcanoes in the carboniferous period, when volcanic action was common in the lagoons of the South of Scotland. In these lagoons volcanic vents and islands covered with tree-ferns projected through the waters in the neighbourhood of Edinburgh, Haddington, Linlithgow, West Fife, and Stirling. At Dalry some ironmasters had a curious experience some years ago. They were working a layer of ironstone at A, Fig. 2, and to reach it to the right thereof, sank a new shaft denoted by the dotted line K D. From the level of the surface soil F H nothing peculiar was encountered, until at E they came upon volcanic rock, through which they bored in the direction D until their hearts were nearly broken. At last they ran a heading at the level of A and in the direction of A, and soon came upon the ironstone. Later on they discovered that they had been boring down the pipe of a volcano E D, in which they might have gone on sinking considerably before they touched bottom.



On Saturday, February 4th, Professor Geikie delivered the last of his four lectures on "Volcanic Action in the British Isles." He said that gradually the coal swamps disappeared, and that in the latter part of the carboniferous period volcanic action had become feeble in these islands; in the Permean period volcanic action was small in extent, but has left its indications in Ayrshire and at Nithsdale; the vent in Arthur's Seat, near Edinburgh, probably belongs to the Permean era. After that time came the sandy plains and salt lakes of the Triassic age, and there was feeble volcanic action at the beginning of that period. Then came a long period of volcanic quiescence; complete transformations in the fauna and flora of this country took place; the age of gigantic reptiles came and entirely disappeared, and the ancestors of our present mammals made their appearance before the last great outbreak, which was larger than all that had gone before. Over an area of 40,000 to 60,000 square miles, including Scotland and the north-east of Ireland, lava then welled up from connected subterranean reservoirs, finding its way through cracks and fissures, and overflowing the plains, thereby forming the large ranges of basaltic rocks, such as are seen in the Giant's Causeway and Fingal's Cave. No such phenomena occurred elsewhere in Europe, although they were paralleled in Western America, India, and Abyssinia. The pitchstone rocks in the Island of Eigg are the latest remnants of volcanic action in Britain. A long period of quiescence has followed, but no geologist would aver that these islands are hereafter outside the range of volcanic action, which is among the possible contingencies of the future.

IMPURITIES IN METALS.

On Thursday, February 4th, Mr. W. Chandler Roberts-Austen, Chemist to the Mint, delivered his second lecture on the above subject.

He said that the ancients tried hard to give the colour of gold to the baser metals, because they thought it would bring them nearer to their aim. He here exhibited a piece of standard gold, of a brilliant and not pale yellow colour, to let the auditory know the true colour of the standard metal; the only other metal possessing a very rich colour is pure copper, but its brilliancy of colour is easily destroyed by slight causes; the alchemists thought copper to be one of the stages in the passage of the baser metals into gold. The colour of pure copper can be destroyed in an instant by dipping it into any solution of arsenic. He next, by experiment, proved that if but a little mercury be rubbed upon tin the latter metal will become brittle, and easily break; mercury will penetrate a thick bar of tin in a few seconds, and in the cold. With a small amount of antimony in copper the red colour of copper disappears, and a delicate violet takes its place.

The Japanese, he said, have given in their works of art great attention to the colours of metals, and the following are the results of analyses of some of their metallic alloys remarkable for their colours:—

Shaku-Do—(Gowland).

Copper	94·50
Silver	1·55
Gold	3·73
Lead	0·11
Iron and arsenic	traces
	99·89

Kuromi.

Copper	98·04
Antimony	1·96
	100·00

Bronze.

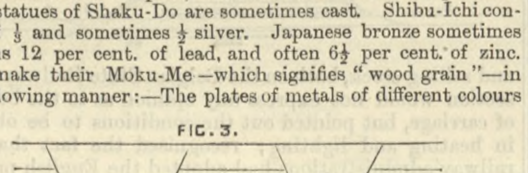
Copper	76·9	to	87·0
Tin	23·1	,,	13·0
	100·0		100·0
	Sawari.		Viarakane (Japanese bronze).

Shibu-Ichi—(Gowland).

Copper	67·31
Silver	32·07
Lead	0·52
Gold	Traces
	99·90

In Shaku-Do, said the lecturer, the amount of gold is very varied in different samples; in some it is as low as 0·5 per cent. Large statues of Shaku-Do are sometimes cast. Shibu-Ichi consists of $\frac{1}{3}$ and sometimes $\frac{1}{2}$ silver. Japanese bronze sometimes contains 12 per cent. of lead, and often $6\frac{1}{4}$ per cent. of zinc. They make their Moku-Me—which signifies "wood grain"—in the following manner:—The plates of metals of different colours

FIG. 3.



are laid over each other in layers, as denoted by A B, Fig. 3; conical holes of different sizes and depths D E are drilled into the layers, which are afterwards hammered down until the holes are filled up, and the composite sheet has parallel exterior surfaces. Copper containing a little gold gives very different colour results to pure copper, and sometimes the Japanese will cut away an upper portion of copper alloy to bring into view an alloy of a different colour below; they also vary the colours of their metallic surfaces by means of pickling solutions, and slight variations of these solutions make very great differences in the resulting hues. The beautiful red tint of some of their works in metal is due to cuprous oxide. Sulphate of copper, verdigris, and salt are among some of the common components of their pickling solutions. The purple of Shaku-Do is supposed to be due to the presence of gold. When metallic copper is deposited from a dilute solution of acetate of copper it oxidises with extreme rapidity in dry air, and even more rapidly in moist air; this copper sometimes changes spontaneously into ordinary copper, with evolution of hydrogen.

Impurities in copper sometimes interfere seriously with the manufacture of brass; if but $\frac{1}{10}$ per cent. of antimony be present in the copper it will hardly affect its colour, but when afterwards alloyed with zinc the colour of the brass is injured; $\frac{1}{1000}$ part of antimony changes the best copper into the worst. Nickel and arsenic in small proportions make copper unfit for the manufacture of any brass at all. Mr. W. H. Preece stated in a paper read before the Institution of Civil Engineers in 1883, that the copper of to-day in submarine cables will carry twice as many messages as the copper used in telegraphic cables up to 1858, and that this improvement is due to the removal of small traces of impurity. The speaker then exhibited and explained the working of the induction balance of Professor Hughes.

THE INSTITUTION OF CIVIL ENGINEERS.

THE INJURIOUS EFFECT OF BLUE HEAT ON STEEL AND IRON.

At the tenth ordinary meeting, held on Tuesday, the 26th of January, Sir Frederick J. Bramwell, F.R.S., President, in the chair, the paper was read on "The Injurious Effect of a Blue Heat on Steel and Iron," by Mr. C. E. Stromeyer, Assoc. M. Inst. C.E.

It was stated that, in spite of the many excellent qualities possessed by mild steel, and in spite of its extended use for ship-building and for marine boilers, many engineers considered it a treacherous material. They were able to adduce numerous instances in which steel plates and bars had failed, in their opinion in an unaccountable manner. In nearly all such cases a cursory examination brought out the fact, that the plates in question had been subjected to bending or hammering while hot, and there could be no little doubt that, while they were being worked, these plates were at a blue heat, or as smiths and boiler makers termed it, a black heat. It should by this time be well known, that such treatment was the most injurious to which steel could possibly be subjected, and therefore such failures could not be properly regarded as unaccountable. Iron possessed the same peculiarity, but being less ductile than steel, similar failures were not so glaring.

The author then mentioned cases in which plates, both of iron and of steel, had failed without this treatment, although the quality of the material was good, according to the usual tests. Three hundred and thirty experiments had been made in connection with the subject of the paper, and consisted mainly of bending and of tension tests. The results were contained in tables and in diagrams.

It appeared that the limit of elasticity of both iron and steel was raised by repeated tension testing. In some cases the limit rose above the original breaking stress, although the ultimate breaking stress was only slightly affected. The total elongation was reduced by previous mechanical operations, while the contraction varied considerably. A test piece which had been shortened when cold showed a reduction of the elastic limit, but another piece which had been shortened when hot showed an increase.

By the expression "blue heat" the author meant to include all those temperatures which produced discolorations—ranging from light straw to blue—of the surfaces of bright steel or of iron. The author showed that steel which had been bent cold, either once or twice, would stand almost as many subsequent bends as the original test pieces. But if the same material was bent once while blue hot it lost a great deal of its ductility. Out of twelve samples, in which two preliminary hot bends were made, nine broke with a single blow of a hammer, and the other three only stood one or two subsequent bends. Thin Lowmoor iron did not break quite so easily, but supported about one half the original number of bends. The following table contained some of these results:—

	Medium Hard Steel. $\frac{3}{8}$in.	Mild Steel. $\frac{3}{8}$in.	Very Mild Steel. $\frac{3}{8}$in.	Lowmoor Iron. $\frac{3}{16}$in.
Unprepared or annealed.. ..	21	$12\frac{1}{2}$	26	20
Broken hot (blue)	$2\frac{1}{2}$	$1\frac{1}{2}$	$2\frac{1}{2}$	3
1 preliminary hot bend	3 mean	$2\frac{1}{6}$ mean	11 mean	12 mean
2 ,, ,, bends.. ..	$\frac{1}{3}$,,	$\frac{1}{3}$,,	$\frac{2}{3}$,,	10 ,,
1 preliminary cold bend.. ..	20	$9\frac{1}{2}$	—	—
2 ,, ,, bends.. ..	$19\frac{1}{2}$	$8\frac{1}{2}$	19	13
4 ,, ,, ,, ...	—	—	18	11
8 ,, ,, ,, ...	—	—	15	6

The experiments all pointed unmistakeably to the great danger incurred if iron or steel were worked at a blue heat. The difference between good iron and mild steel seemed to be—that iron broke more readily than steel while being bent; that iron suffered more permanent injury than steel by cold working, but that if it had successfully withstood bending when hot, there was little probability of its flying to pieces when cold, like mild steel.

It was a common practice amongst boiler-makers to take the chill out of a plate if it required a little setting, or to set a flanged plate before it was cold. This was nothing else than working it blue-hot, and should not be allowed. All hammering or bending of iron and steel should be avoided, unless they were either cold or red-hot. Where this was impossible, and where the plate or bar had not broken while blue-hot, it should be subsequently annealed. It was satisfactory to learn that since the introduction of mild steel a practice had been gaining ground amongst boiler makers, which must have the effect of guarding against such failures, and should be encouraged. It consisted in the cessation of work as soon as a plate which had been red-hot became so cool that the mark produced by rubbing a hammer handle or other piece of wood over it would not glow. A plate which was not hot enough to produce this effect yet too hot to be touched by hand, was most probably blue-hot, and should under no circumstances be hammered or bent.

The theory that local heating of a plate set up strains which sometimes caused failures, did not appear to be supported by the experiments. But it was doubtful whether the proposal to locally re-heat a plate, which had been worked when hot, in order to anneal this part, should be carried out. Several test pieces were made red-hot or blue-hot, and then were slowly cooled, by holding one of their edges in cold water, As might have been expected, the medium hard steel lost much of its ductility. The other steels and the iron were not greatly affected, as would be seen from the following table:—

	Medium Hard Steel.	Mild Steel.	Very Mild Steel.	Lowmoor Iron.
Unprepared or annealed.. ..	21	$12\frac{1}{2}$	26	20
Quenched red-hot in boiling water..	21	10	—	—
Quenched red-hot in cold water..	1	10	19	20
Red-hot quenched edge in cold water.. -	3	8	25	27
Blue-hot quenched edge in cold water..	3	$6\frac{1}{2}$	19, 19	21, 14

The author concluded by suggesting that the question should be further investigated, and that steel manufacturers should endeavour to ascertain whether every quality of steel was made permanently brittle by being worked at a blue heat, or whether this was independent of the various impurities contained in it; and also whether prolonged exposure to a blue heat could produce the same effect.

RAILWAY MATTERS.

FORTY miles more of extension of the Manitoba and South-Western Colonisation Railway, from Carman to Holland, were opened for traffic a few days ago.

IN the works on the Derwent Valley, Tasmania, Railway there has been, an Australian paper says, an extraordinary muddle. It states that the recent floods carried away a large portion of the line, owing to the culverts being too small. Three different plans were made of one culvert, and the bridges declared dangerous.

THE Paris, Lyons, and Mediterranean Railway Company possesses 4783 miles of line. The earnings of the year 1885 reached £12,325,273 as against £12,726,452 in 1884, or £2416 per mile. The largest earnings in France per mile are by the Northern Railway—2160 miles—namely, £2829 in 1885, and £3010 in 1884. In Austria only 113½ miles of new railway were opened in 1885 as compared with 566 in 1884; in Hungary, 194 miles, against 211 in 1884.

AT the meeting of the Hull and Barnsley Railway Company on the 22nd inst., a report was read, dealing with the first five months of work of the new railway and dock. The passenger mileage reached 318,456 miles. The gross receipts were £54,848, and working expenses £48,138, or 87 per cent., which seems very high, but a set of plant designed for very large traffic cannot but work expensively upon a small traffic. A total of 97,000 tons had been dealt with at the docks, making 166,291 tons since opening. The meeting was rather stormy, and the utmost dissatisfaction with every point in the financial operation of the line was expressed.

THE London and South-Western Railway Company has been adjudicated by a jury at the Hampshire Assizes as liable to pay damages for a prairie fire on a small scale, caused by one of their engines in running between Ringwood and Bournemouth. The large tract of heath outside Bournemouth, and the peaty ground on which it grew, were so dried up by the hot, sunny weather last summer, as to be in a highly combustible condition. The South-Western Company is said by a local paper to have "put on an engine built nearly thirty years ago, in which the natural tendency of steam engines to emit sparks was not under adequate control," and on Lord Malmesbury's estate alone 650 acres were set in a blaze. A "natural tendency" is not always "under adequate control" even after thirty years.

THE American papers are all describing the invention of Mr. Edison for sending and receiving messages on a moving train. *Science* says it was successfully tested on February 1st on the Staten Island Railroad. The operator sat in the middle of the centre car of the train, before a desk furnished with a Morse telegraphic key. He held a telephone at each ear. Under the desk was a battery. From this a ground wire was connected with the car axle and the rail. Another wire passed through the key and to the roof of the car, which was connected with the roofs of the other cars by short pieces of copper wire. Parallel with the railroad were the telegraph wires of the Baltimore and Ohio Company. The induction between the metal roof and the telegraph wires was sufficient to allow of the reception by telephone of Morse signals.

THE annual meeting of the North London Steam Tramways was held at the Guildhall Tavern on the 18th inst., and from the report placed before the proprietors it appears that the change from horse to steam haulage has shown satisfactory results. The line is worked now by fifteen Merryweather engines, with 7½in. by 12in. steam cylinders and air condensers. The line was originally a horse tramway, but the permanent way on the Edmonton road has been altered and strengthened, and the new lines to Finsbury Park laid specially for steam. The steam engines commenced to work the partial service on April 2nd, and horses were finally dispensed with on May 31st. The fuel consumed on the engines averaged 9 lb. per mile. A Bill to empower the North London Tramways to construct additional tramways, to raise new capital, and for other purposes, was submitted, involving an expenditure of about £48,000 to £50,000, and was passed.

ON Monday on the Lancashire and Yorkshire Railway, near Burnley, a goods train had been shunted on to the off line for an express from Burnley to pass through, and was on the point of crossing over to the other line when it was run into by a luggage train coming in the opposite direction. The signals were against the advancing train, and the powerful steam brake was applied, and the engine reversed. These means proved ineffectual to stop the train, which dashed down the incline, and thus the collision was brought about. The collision is stated to be due to the slippery nature of the rails and the weight of the train, which consisted of forty wagons laden with stones, casks of oil, and other heavy materials. The drivers escaped injury by leaping from the engines. One of the engines was hurled down the embankment, dragging with it a dozen wagons and contents. Part of the line was torn up, and the second engine wrecked. The necessity for more effective goods' train brakes is here evident.

THE accident which occurred on the 18th November, between Yelverton and Bickleigh stations, on the Launceston branch of the Great Western Railway, over which the London and South-Western Company has running powers, is the subject of a report by Major General Hutchinson. As the London and South-Western Company's train from Exeter for Plymouth was proceeding on its journey, the train left the rails at a spot about 1 mile 27 chains from Yelverton; after running about 100 yards, the engine, tender, and front van broke away from the rest of the train, and were, after the engine had run into a rock face on the right of the line, precipitated down the slope of an embankment, where the engine and tender came to rest wheels upwards; the van became detached from the tender but remained on its wheels with its rear end jammed against the junction of the engine and tender. The rest of the train, consisting of six vehicles, was off the rails to the right but remained on the ballast, just short of the spot where the engine must have crossed the line after striking the rock, or in a distance of about 100 yards from the first mark of a wheel having left the rails. Three passengers complained of slight injuries, and the driver was fatally injured; the fireman and head guard were badly shaken and bruised. He says:—"Upon full consideration of the evidence and examination of the spot, and of the engine which drew the train, I find it very difficult to determine the probable causes of this serious accident on a curve of 20 chains radius on a falling gradient of 1 in 58. The permanent way was in very good order. There was, however, the serious fault of excessive super-elevation of the outer rail, viz., about 7½in., on a curve of 20 chains radius. This is calculated for a speed of about 50 miles an hour, whereas on such a line as the Launceston branch, abounding in reverse curves and steep gradients, the speed should not exceed about 30 miles an hour, and the super-elevation should not be more than 3in. Supposing the weight on the leading wheels of the engine to have been the same as when the engine was weighed last May, viz., 13·5 tons, the effect of canting up the right wheel 7½in. would be to diminish the weight on that wheel—theoretically—to about five tons, and to increase that on the left wheel to about 8·5 tons; the right leading wheel would thus be in a condition favourable to mounting. Oscillation might well have been induced looking to the nature of the line for the 20 chains previous to the first indication of a run-off, in which length there are no less than four reverse curves of 30 and 20 chains radius, separated by short portions of straight line, and a change from level to a falling gradient of 1 in 58 only 7 chains before the first mark. It is, then, to these two causes combined, viz., unnecessarily large super-elevation of the outer rail of a curve of 20 chains radius and probable oscillation, that I think the accident is most likely to be attributed. The automatic vacuum brake doubtless did good service in preventing the accident from being far more serious than must otherwise have been the case." One rail was found broken into six pieces, but it is supposed that was a result and not a cause, and it may be remarked that the above calculated weight on the leading wheels is only true when the engine is standing.

NOTES AND MEMORANDA.

A NEW method of determining the heat of combustion of organic substances has been described by D. Diaconoff—*J. Russ. Chem. Soc.*, 1885, 283-284. He burns the compound under investigation in admixture with finely-powdered asbestos and glycerol; the former divides the particles of the difficultly-combustible substance, and secures its entire combustion, the latter maintains the temperature necessary for combustion.

A SIMPLE method of obtaining the height of water in tubes driven into the ground to test the effect of the pumping on the underground-water level, has been described. The elevation of the top of each test tube being determined, the exact distance to the water surface was obtained by lowering a small lead weight, to which was attached a piece of metallic potassium, by which the moment of contact with water was indicated by report and by flash.

IN a letter in reply to an epistolary communication of certain arguments as to the dimensions and relative distances of molecules advanced by Mr. Jules Bourdin, and published in *La Lumière Electrique*, Professor Clausius says, that the mean path of the molecules, multiplied by eight, is to their diameter as the total volume occupied by the gas is to the volume occupied by the molecules; and that if the gas departs from the law of Boyle and Gay-Lussac, the departure is due to several causes, one of which is that the volume actually occupied by the molecules cannot be neglected as compared with the total volume of the gas. He also says, that in order to explain the propagation of luminous waves across space, it is requisite to admit the existence of a matter susceptible of more subtle division than the ponderable gases; this is the matter to which at present the name ether has been given; Professor Clausius deems it no other than electricity

HERREN BLEININGER AND HASSELMANN, two German chemists, have described a method of making facing materials for inner walls likely to become damp. After drying and grinding the clay, they make a mixture of clay, 91½ parts; iron filings, 3 parts; common salt, 2 parts; potash, 1½ parts; elder or willow wood ashes, 2 parts. The whole is heated to a temperature varying from 1850 to 2000 deg. Cent.—3362 to 3632 deg. Fah. At the end of from four to five hours the argillaceous mixture is run into moulds, then re-baked in the ovens—always protected from the air—at a temperature of 842 to 932 deg. Fah. The product may be variously coloured by adding to the above 100 parts: 2 parts of manganese for a violet brown, 1 part of manganese for violet, 1 part of copper ashes for green, 1 part arseniate of cobalt for blue, 2 parts of antimony for yellow, and 1½ parts of arsenic and 1 part oxide of tin for white. The *Scientific American* says these products resist the action of acids, and are well adapted for sewers, &c.

FOR some time past Messrs. W. Crookes, F.R.S., Dr. Odling, and Dr. Tidy have been directing their attention to the examination of the water of the metropolis by so-called biological methods, from the application of some of which, at any rate, results of importance may doubtless be ultimately arrived at; but several months at least may be expected to elapse before they will be in a position to include any results furnished by this manner of examination in their ordinary reports. In justification of their caution in the matter, they think it only right to observe that the chief authorities in bacteriology in this country are not satisfied as to the trustworthiness even of the methods of biological examination as yet practised by chemists; while, having regard to the fact that every breath of air we draw is laden with so-called germs, they look upon the estimation of the number of germs in a given volume of water, irrespective of any determination of the beneficent or pathogenetic nature of these germs, as a result from which no hygienic inference of any kind can be drawn.

THE experiments on a new form of calorimeter referred to in this column of our last impression were performed by Professor Barrett at temperatures varying from −1 deg. to 26 deg. Cent., and as it was important that the same thermometer should be used in different experiments, and even advisable to use the same part of the scale of the thermometer, the following expedient was devised:—The thermometer was first heated to the highest temperature required in the experiment, and by the application of a flame to the mercurial column just below the enlarged space at the end of the tube, that part of the mercury above the flame was broken off and driven into the space, where it remained when the thermometer was cooled. By this means the relative value of a scale division was only inappreciably affected, while the absolute value could be obtained from a single comparison with a standard. From an examination of the results obtained, the author concluded that for further accuracy in this kind of work we must look for improvements in the methods employed, the instruments having, he believes, attained to a state as near perfection as possible.

IN a paper on "The Formation of Rain, Hail, and Snow," recently read before the Meteorological Society by Mr. A. W. Clayden, F.G.S., the author points out that all observations tend to show that, except under quite abnormal conditions, the temperature of the atmosphere falls as the height above sea level increases; and there seems no reason whatever for assuming that the law does not apply to that portion of the atmosphere which forms a cloud. Hence, if a drop were to be formed at or near the upper surface of a cloud, it would fall down into a region saturated with vapour at a temperature above its own. The result will be further condensation producing a larger drop; and this process will continue until it leaves the cloud. If its temperature be below the dew point of the air it falls through, condensation will continue until it reaches the ground. However, it is obvious that this subsequent gain cannot bear any very large proportion to the growth while falling through the saturated cloud, from which the conclusion follows that the size of the drop must increase with the thickness of the cloud. The author suggests that condensation begins on the upper surface of the cloud by the cooling of some of the liquid cloud particles. If this particle is could enough it will solidify, and snow will be formed. Should it not be quite cold enough to solidify at once, owing to its minuteness, but remain still below the freezing point, hail is formed. Finally, if the temperature is not low enough for either snow or hail, rain is produced.

SOME experiments on the influence of temperature on the strength of iron and steel were recently described in the *Gorny Jurnal*—Russian mining journal—by B. Papkoff. All the specimens tested were taken from soft steel and iron plates, three samples being cut from each plate. One sample of each group was tested at the ordinary, and two at low temperature, with the results given—"Proceedings" Institution of Civil Engineers—in the following table:—

Materials tested.	Temperature. Fah.	Ultimate strength in tons per sq. in.	Percentage of elongation in 8in.	Time of exposure to cold.
Three strips of de-	+63½	22·73	25 9	—
phosphorised steel	− 2	23·75	25·5	1 hour.
plate	− 2	26·10	27·6	3½ hours.
Three strips cut out	+63½	17·91	10·1	—
of iron plate, length	− 2	20 00	14·0	2 hours.
with the grain ..	− 2	19·30	16·3	2½ hours.

Both the ultimate strength and the percentage of elongation increases very sensibly with the decrease of temperature, a result which was to be expected because the greater rigidity due to contraction caused by cooling, makes contraction by mechanical tension more difficult; but this may be true only under increasing tension gradually imposed, and may not apply at all in case of impact.

MISCELLANEA.

THE water supply of Pontefract is just now attracting attention, and the opinion prevails that a fresh supply will have to be sought.

AMONG our list of tenders we gave last week Mr. Radford's address as Angel-row, Birmingham, instead of Angel-row, Nottingham.

THE arrangements in connection with the exhibition to be held in Birmingham during August and September next are being pushed rapidly forward.

THE economy of the triple-expansion engines with 150 lb. to 160 lb. has proved so great that more than one firm of engineers is producing quadruple engines, and it is said, "expect to attain to a working pressure of 280 lb."

IT is intended to construct a breakwater two miles long on the southern bight of Trial Bay, near the entrance to Kempsey, New South Wales. The work, which will extend over thirty years, is to be carried out by convict labour.

THE American Elevator Company has been awarded the contract for five hydraulic passenger elevators, to be erected one each in the five blocks of residential flats in Carlisle-place, Victoria-street, by Mr. George Bains, for Messrs. J. W. Hobbs and Co.

AFTER a trial of Smith's patent "convertible" pulleys by the Government, Messrs. Smith and Grace, of Thrapston, the sole manufacturers, have just received an order for a further supply of 300. These pulleys were recently illustrated in our columns.

OWING to the imperative need of increased fire protection for the suburban districts of the metropolis, and the pressure brought to bear by the vestries concerned, the Metropolitan Board of Works, at their meeting on Friday last, decided to order three additional steam fire-engines from Messrs. Shand, Mason, and Co. It is hoped that when the Bill now before Parliament to provide for a higher fire brigade rate becomes law, an increase will be made in the number of fire-escapes in the outlying districts.

THE *Sanitary Plumber* reports the greatest discovery of natural gas yet made in Ohio, which occurred at Tiffin on the 19th ult.: "A well at that place was torpedoed with 400 lb. of rackarock and 25 lb. of nitro-glycerine, at a depth of 156ft. There were 300ft. of oil in the well at the time, and this was thrown to a height of 125 lb. in the air, and was followed by an escape of gas. Over 200,000ft. of gas flowed during the night, and it is now steady at about 100,000ft. per day. Oil in considerable quantities for lubricating purposes has filled the well, and flows in a steady stream."

THE Canadian Deputy Minister of Marine has issued information to agents and others on the Atlantic coast as to a scheme which is being perfected by the Prince of Monaco and the French Admiralty intended to determine the direction and force of the Gulf Stream. It is proposed to construct a number of floats which will be launched at intervals, and as they are likely to be washed ashore by the current and the action of the wind and sea, the Canadian Marine Department's agents are instructed to be on the look-out for them, and to report each one found at once to the Department.

ACCORDING to Messrs. Moss and Co.'s "Steamship Circular," "the anticipation that a very considerable reduction of tonnage would be shown when the returns of the output for 1885 were made up, has proved correct. Statistics are briefly thus:—Tonnage built in U.K., 1883, 1,250,000 tons; 1884, 958,000 tons; and 1885, 540,000 tons; or a reduction of 750,000 tons on the output of two years since. This should have a serious effect on the value of steam shipping, and if, as seems very probable, the output of 1886 will be even lower than 1885, we may then reasonably hope that the excessive over-production has been fairly checked, and that supply and demand will be more evenly balanced."

IN the House on Monday a question was asked respecting the arming of English soldiers with German-made swords and bayonets, and the answer given was of the lamest kind, and shows that we in England ought to look at home before we apply adjectives in denouncing the want of honesty in foreign military contract departments. Part of the answer was, "Orders for swords have not been given and will not be given to the foreign trade when the number required within a given time can be procured from the home trade aided by the Government factory at Enfield." When could not the home trade provide all required if the orders were properly disseminated, and why should orders be driven off by incompetent officials until there is so much hurry?

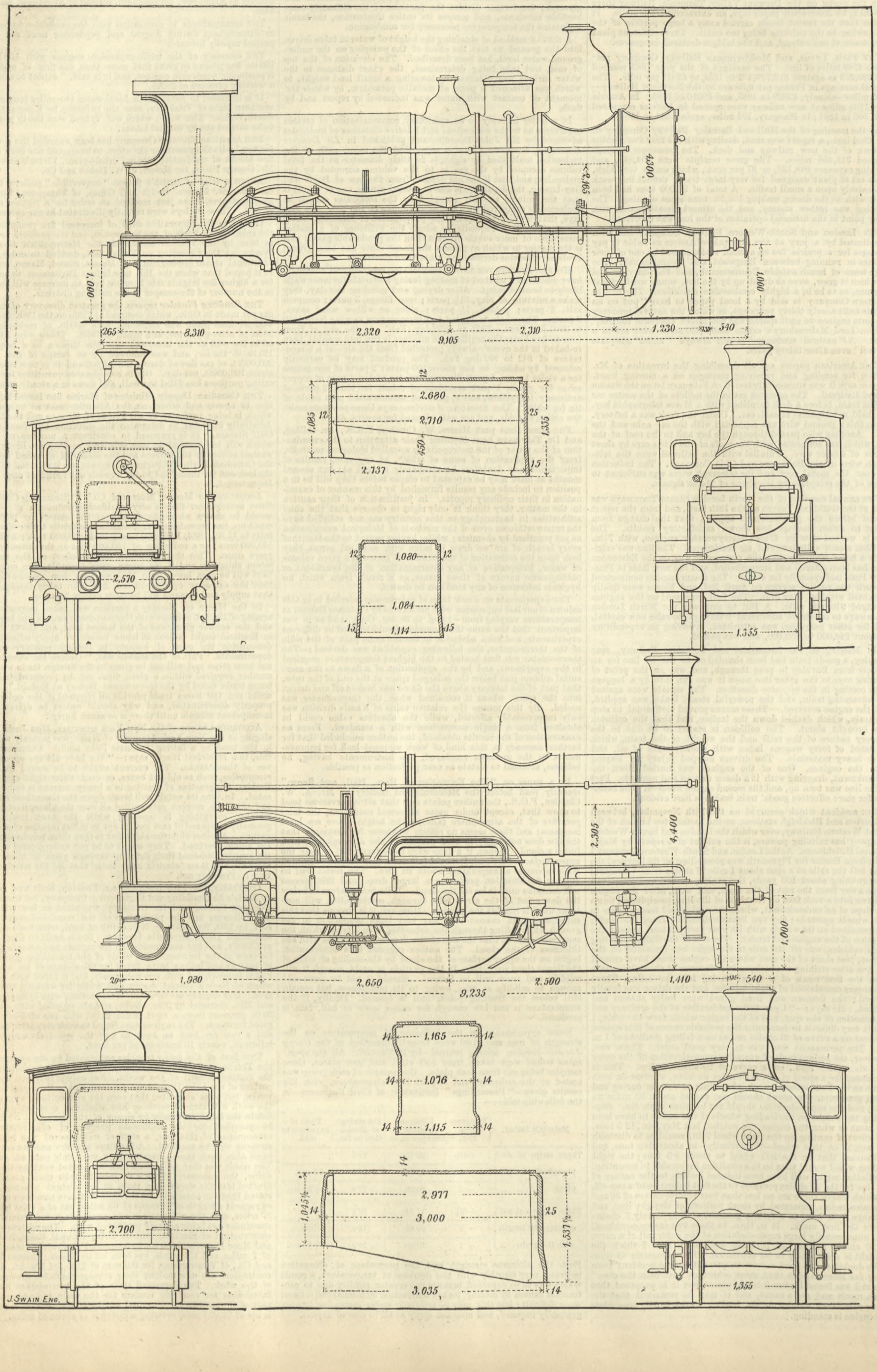
ACCORDING to one of the New York reporters, Miss Juch, whilst singing at the New York Academy of Music, was severely wounded in the head by a falling "electric light tank." Commenting on this, the *Electrical World* says:—"We have always opposed the use of these tanks. The current ought to be stored in lighter receptacles, such as old hat boxes, or even water-tight egg boxes. Besides, the practice of putting in a heavy current is to be deprecated. In time its weight will break down the staunchest support, and then the current gets spilled all over the place, irretrievably staining everything it touches; while the tank itself, being generally composed of cast iron, is apt to inflict injuries of a serious nature. Another objectionable point is that these ponderous tanks are slung overhead. They ought to be put underground or under the boards, and send their light up through glass or mica. But, after all, was it an 'electric light tank' that did the mischief this time? Probably not."

ON Friday, the 12th inst., the s.s. Freiston, built and engined by Earle's Shipbuilding and Engineering Company, for the Boston Deep-sea Fishing and Ice Company, was taken on her trial trip. The following are the particulars of the vessel:—Length B.P., 85ft. by 19ft. 9in. beam by 10ft. depth of hold, with flush deck aft and small raised forecastle forward. She is built to Class 90 A1 at Lloyd's, and has accommodation for captain and officers aft and for crew in the forecastle, the whole of the remaining space clear of engines and boilers being fitted for the storage of ice and fish. She is ketch-rigged with two pole masts, and is fitted with a steam winch of Earle's special design and make for working the trawl gear. Her engines are inverted direct-acting, with cylinders 12in. and 22in. diameter by 20in. stroke, and are supplied with steam of 90 lb. pressure from a steel boiler fitted with one of Fox's corrugated furnaces. The engines were found to work very satisfactorily, and a run for half an hour to test the speed showed, we are informed, nearly 10 knots speed per hour.

THE first of the many troubles anticipated by the opponents of the Thirlmere water scheme has arisen almost immediately upon the commencement of the works. Not only is it feared that this portion of the Lake District will be destroyed by the aqueducts and works, but it is suspected that even the men actually engaged on the work will cause something like wholesale destruction of the fish in the lakes, especially by means of the dynamite which will be provided for the legitimate purpose of construction. In consequence of this fear, a staff of watchers of the lakes and streams will be required. A few days ago the navvies employed upon this work struck because they were only paid 4d. an hour. The result was that while these men were out of work by their own doing, the necessary number of men to take their places were drafted into the works from more or less distant quarters. It is stated that the easements for the aqueduct have now been arranged as regards a length of upwards of 63 miles, out of a total length of 87 miles, and the negotiations and proceedings for acquiring the remainder are being actively proceeded with. The contract for the construction of the long tunnels under Dunmil Raise, Nab Scar, and Moor Howe, and the works connected therewith, a total length of 7 miles and 174 yards, has been let to Messrs. Thomas Vernon and Co., of Westminster, for the sum of £125,531 15s. 8d., and the contractors are now making their arrangements for the execution of the work. The depressed state of the iron market has been favourable for receiving tenders for the main piping required as part of the aqueduct. The total weight of cast iron pipes required is about 51,000 tons, covering a distance of about 45 miles.

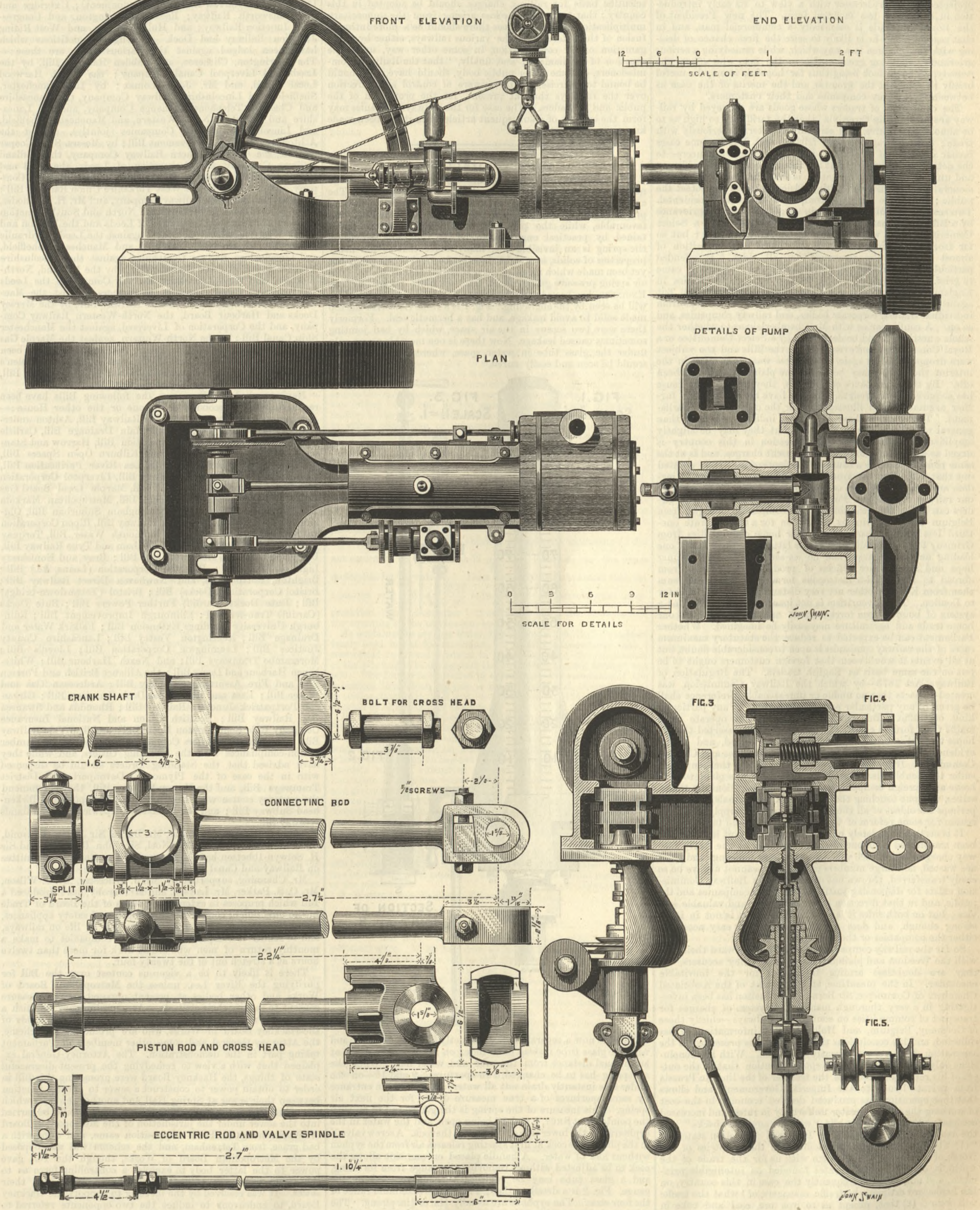
PASSENGER AND EXPRESS LOCOMOTIVES, BELGIAN STATE RAILWAYS.

For description see page 161.)



HORIZONTAL ENGINE.

THE LONDON AND COLONIAL ENGINEERING COMPANY, ENGINEERS, LONDON.



HORIZONTAL ENGINE.

THE accompanying engravings represent one of a series of horizontal engines made by the London and Colonial Engineering Company, of Lombard-street, from the designs of Mr. G. A. Goodwin, of Victoria-chambers, Westminster, and called the "Scotian" engine. Our engravings are very full, and are self-explanatory of all they convey. The dimensions are given of the engine illustrated, which is of 4-horse power nominal. The cylinder is 6·75 diameter and the stroke 10·75in., the number of revolutions 168. The fly-wheel is 49in., and weighs 4·5 cwt. The 6, 8, 10, 12, 16, and 20-horse engines have cylinders respectively of 8·25, 9·5, 10·5, 11·25, 12·5, and 14·5 inches diameter, and 13, 15, 15, 17·5, 21·5, and 27 inches stroke, so that they are all large in proportion to nominal power.

THE RAILWAY RATES CONTROVERSY.

THE announcement made a few weeks ago by the then President of the Board of Trade, Mr. E. Stanhope, that the Government intended to propose legislation on the much-vexed question of railway rates pleasantly revived the hopes of traders, and, at the same time, the anxiety of railway companies. Chastened by previous experience, commercial men, probably were not very sanguine that the dispute between them and the railway companies would this year be satisfactorily settled, but the introduction of a new Bill on the subject promised, at all events, to advance the matter a step or two, and they naturally hailed Mr. Stanhope's intimation with gladness. Suddenly, however, has come the defeat of his party, and the accession of a new Ministry, loaded already with obligations and duties which threaten to thrust aside railway rates and all other questions not Irish and not purely agricultural. This, of course, largely depends on the duration of the present Administration. If they have but a brief career they cannot take up the legacy of a Railway Rates' Bill, but if they establish a firm position they will certainly be pressed to do something with this subject. Without any promise of a new measure the question would have been re-agitated this year, for dissatisfaction in the trading community has grown apace since last session, and the prospect of a further effort to solve the problem has added force to the feeling of discontent. Merchants, manufacturers, and Chambers of Commerce have become more restive and more resolved on a reform, and a recently published report by Sir Bernhard Samuelson, M.P.—a prominent authority on this subject—has furnished them with fresh weapons for a renewal of the contest. They must perforce abide the issue of the present Parliamentary complication, but unless that issue be another dissolution they will not be slow or gentle in jogging the Board of Trade. Happily, there is reason to believe that that department will not require much jogging, for it is understood that Mr. Mundella has already taken up the Bill projected by his predecessor with a view to its early introduction in a more or less modified form. The new President of the Board of Trade is essentially a commercial man, and in that respect alone he is likely to seize the first chance of dealing with the question in a way which, while remedying a serious grievance, will bring great credit to the man who effects the remedy. The outlook being thus far hopeful, it may be useful briefly to glance at the grounds and the merits of the case as between the railway companies and their customers.

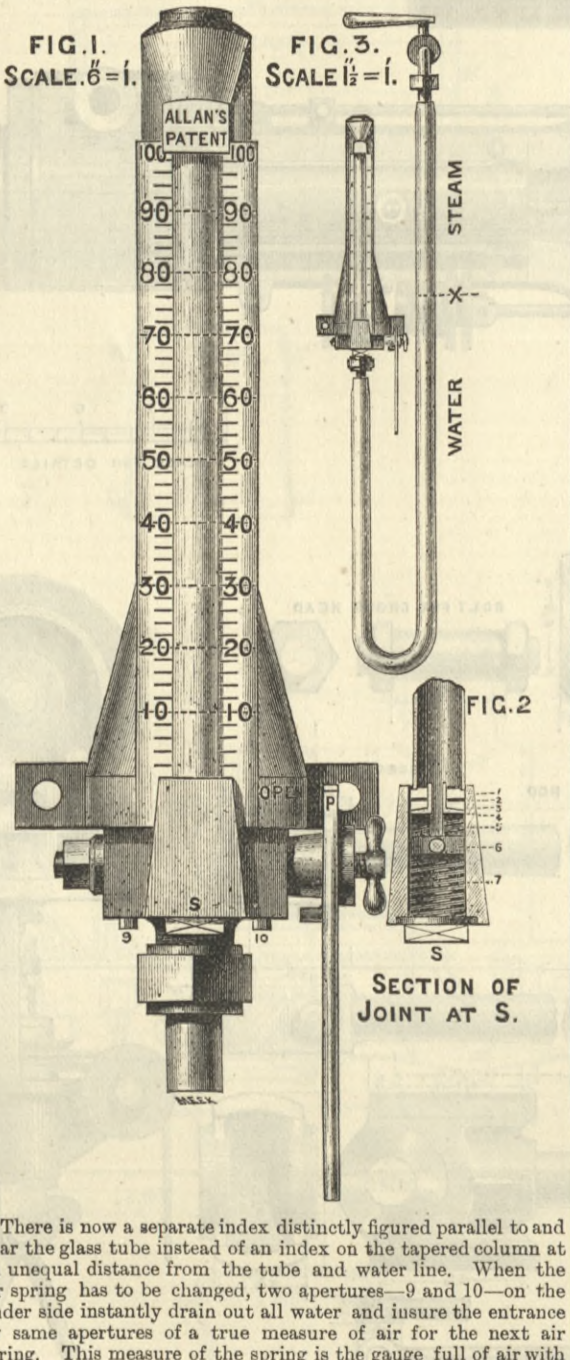
The complaints of traders whose goods are conveyed by railway are in the main three, viz., that the tariffs are so high as to be almost prohibitive, and certainly do interfere seriously with trade; that the rates are not fairly levied, but in some cases favour one class of customers—including foreign producers—to the detriment of others; that the terminal charges are arbitrary and unjust. A fourth allegation is that the Railway Commissioners are not invested with sufficient powers to protect the public; and there are other complaints, minor and incidental. Two sessions ago Mr. Chamberlain sought to meet the grievance by a Bill, based mainly upon the recommendations of a Select Committee which was appointed in the previous year; but so far from succeeding, the measure aroused the opposition of almost everyone else concerned, on all sides. It offended particularly in regard to "terminals," and speedily came to grief. Last year the nine leading railway companies in England introduced each a Railway Rates and Charges Bill, but against them were presented some hundreds of petitions from individual traders, corporate bodies, and railway companies, and so on. A conflict arose with Mr. Chamberlain as to whether the whole question should be dealt with by a Select Committee or a Royal Commission, and eventually all the Bills and the subject were dropped. Thus again no progress was made; but in the interim those who may be called the plaintiffs have not been idle. By the continuance of the evils, they allege, their cause has acquired fresh strength, and they have been collecting further arguments and illustrations for the conversion of Parliament. The points we have mentioned indicate in a more than general way the nature of the issue, but they may be slightly amplified. The long-continued depression in this country is urged as a reason for lowering the present charges, and is at the same time assigned as a cause of the depression. It is pointed out that while the rates from place to place in the United Kingdom are excessive, foreign competitors are distinctly assisted by our railway companies. For example, it is found that iron girders can be, by the generosity of the companies, brought from Belgium through Grimsby to London for a through-rate one-third less than is charged for similar home commodities from Grimsby to London, although in the latter case there is but one loading and one transit, and no sea-service. In like manner hops and many other articles of produce are brought from abroad to the English metropolis for a considerably less sum than from Kent, or other not very distant parts of the country to London. This favouritism is not inaccurately described as a system of bounty upon foreign goods, and its effect upon our home trade and agriculture may easily be imagined. Whether Parliament can be expected to reduce the statutory maximum rates of the railway companies is open to considerable doubt, but at all events it would seem that foreign customers ought to be put on the same basis as English traders. The Regulation of Railways Act 1873—by which the Railway Commission was created—enacts that no undue or unreasonable preference shall be given to any particular person or company, or any particular kind of traffic. But this provision does not operate upon traffic from foreign countries. Moreover it is asserted that at home the Act is in this respect flagrantly violated, and strong evidence upon this point was given to the Rates and Charges Committee. If so, those who are not favoured by the companies, suffer the double disadvantage of preferential rates given to both home and foreign competitors. These considerations by themselves, without touching the question of "terminals," which is perhaps the oldest of all the grievances, seem to supply abundant reason for some reform of the existing system and law.

It is certain that lately more than one important industry has been transferred from one district to another by the heavy railway charges, and in each such case expensive buildings and plant are wasted, and large numbers of men, who cannot always be so easily transferred, thrown out of work. The Railway Commission exists for dispensing justice between the companies and the public, and in that direction it has done great and valuable service; but on both sides it is felt that this Court is not in itself strong enough, and does not afford sufficiently easy access to either the companies or their customers.

So far the railway companies have not put forward their case with the freedom and plainness displayed by their accusers, but they are doubtless arming themselves for the inevitable encounter. In the meantime, at the request of the Associated Chambers of Commerce, Sir Bernhard Samuelson has been investigating in a very thorough manner the system of charges for transport of commodities on continental railways—chiefly those of Germany, Belgium, and Holland. The information he has collected, and his conclusions therefrom, he has presented to the association in a report recently published. With his conclusions only can we now deal, except to mention that at the outset of his report he describes the transfer of the lines in Prussia from private hands to the Imperial Government, and shows that that operation has produced decided economy in the cost of working the traffic, greater uniformity in rates, and increased accommodation to the public, "without any drawbacks." As the results of his inquiries, Sir Bernhard Samuelson states:—"(1) That the traffic in commodities in the countries of the North of Europe, which compete with us for the trade of the world, is carried on under rates founded on intelligible principles, and not, as is too frequently the case in this country, on the haphazard estimate, by traffic managers, of 'what the traffic will bear;' (2) that, except as to iron ore, coal and coke in certain cases, and a few other articles under special circumstances, the rates are so much lower in those countries as to place our traders at a serious disadvantage; (3) that the result to the railways of the continental system of charges and conveyance, as tested by the proportion of net to gross receipts, taking into account their low passenger fares, does not compare unfavourably with ours; (4) the agriculturists in those countries are not subject to unfair competition with foreign produce, by rates lower than those charged on the same articles of home growth; (5) that the charge for terminals included in the foreign tariffs are confined to loading and unloading, and a definite and very moderate addition, which is almost a necessary corollary of the system of mileage rates; (6) that the transfer of railways to the State in Prussia has not increased the charges on traffic, but has rather had the contrary tendency; and that, although a full price was paid to the shareholders, the transaction has been profitable to the State." In supplement to these conclusions, Sir B. Samuelson expresses the opinion that, in view of the close competition between this country and the countries of Northern Europe, our trade, and consequently the traffic on our railways, is in danger of suffering loss unless our railway rates are "promptly and thoroughly revised," and suggests that a more scientific basis for railway charges should be adopted in this country; that to obviate the loss arising from the unnecessary multiplication of train services there should be a more intimate fusion of the interests of the various railways, either by amalgamation or by consolidation, in some other way, under the sanction of Parliament; and finally, "that the Railway Commissioners, or some other public body, should have, and should be bound to exercise, greater powers of control and direction over the railways than at present, for the protection of the public and of traders. The case for the railway companies may form the subject of a subsequent article when it has been made known in its latest aspect.

ALLEN'S GAUGES.

THE accompanying engraving illustrates an improved gauge now being introduced by Mr. Allen, of Scarborough. The experience and testimony of users of the ordinary class of pressure gauges now made continues to be sometimes unfavourable, while the principle of the air gauge is maintained by practical engineers to be the right one. Because the spring is an invisible one, many forget that it has many properties of solids, as weight, inertia, &c., and no air gauge has yet been made which meets modern scientific requirements. The air spring pressure gauge, which has been twice noticed by THE ENGINEER, has been in the latter part of 1885 much improved, as will be seen by the engraving. Fig. 1 is a front view with the top made solid to avoid leakage, and has a hermetic seal. Formerly there were two screws in the air space, which by bad jointing sometimes caused leakage. Now there is one movable screw only under the glass tube in water space, where a drop of water would be seen and easily cured.



There is now a separate index distinctly figured parallel to and near the glass tube instead of an index on the tapered column at an unequal distance from the tube and water line. When the air spring has to be changed, two apertures—9 and 10—on the under side instantly drain out all water and insure the entrance by same apertures of a true measure of air for the next air spring. This measure of the spring is the gauge full of air with the pointer P at SHUT, 9 and 10 being open, and the water in the syphon up to the lower side of the plug of the cock. A screw valve V in the plug of the cock at first starting releases air from the syphon without loss of water. A handle placed on one side allows the cock to be adjusted without removing the gauge from its fixing, and a glass tube may be replaced without removal of the gauge. Fig. 2 is a detail section; Fig. 3 gives maximum range of the four sizes. The syphons are usually ½in. or ¼in. piping. The volume of water is about the contents of the gauge.

PRIVATE BILL LEGISLATION.

WITHIN a few days of the reassembling of Parliament for real business, a fair amount of progress was made with private Bills in the several stages. Beginning with the Standing Orders stage, the following are among the Bills which have complied:—The London, Brighton, and South Coast Railway Bill; Lambeth Water Bill, London and South-Western Railway Bill, Midland Railway Bill, Southwark and Vauxhall Water Bill; London, Chatham, and Dover Railway Bill; Beaconsfield, Uxbridge, and Harrow Railway (Abandonment) Bill; and Uxbridge and Rickmansworth Railway Bill; the Dore and Chinley Railway Bill; and the Manchester, Oldham, and Rochdale Street Tramways Bill; the London, Brighton, and South Coast Railway; Lambeth Water, Cambridge University and Town Water, East and West Yorkshire Union Railways, Felixstowe Railway and Dock, London and South-Western Railway, Midland Railway; Exeter, Teign Valley, and Chagford Railway; Southwark and Vauxhall Water, Burgess Hill Water; London, Chatham, and Dover Railway; Pewsey and Salisbury Railway; Beaconsfield, Uxbridge, and Harrow Railway (Abandonment); Uxbridge and Rickmansworth Railway; Radstock, Wrington, and Congresbury Junction Railway; and Hull, Barnsley, and West Riding Junction Railway and Dock. Among the petitions which have been lodged against the various Bills are these:—The Accrington, Clitheroe, and Sabden Railway Bill, by the Leeds and Liverpool Canal Company; the Great Harwood Local Board, and Mr. John Lomax; by the Manchester, Sheffield, and Lincolnshire Railway Company, the Lancashire and Cheshire Telephone Exchange Company, and the Lancashire and Yorkshire, North-Western, and Manchester, Sheffield, and Lincolnshire Railway Companies (jointly), against the Ashton-under-Lyne Improvement Bill; by Messrs. S. T. Cooper and Co., the Great Northern Railway Company, the Midland Railway Company, the Corporation of Leeds, the Hull and Barnsley Railway Company, and the North-Eastern Railway Company, against the East and West Yorkshire Union Railway Bill; by the Great Northern Railway Company, and Mr. H. E. Rhodes, against the Halifax High Level and North and South Junction Railway Bill; by the Corporation of Leeds and the London and North-Western Railway Company, against the Leeds Hydraulic Power Bill; by the Great Northern and Manchester, Sheffield, and Lincolnshire Railway Companies, against the Lincolnshire Marshes and East Coast Railway Bill; by the Midland, North-Western, and West Lancashire Railway Companies, the Leeds and Liverpool Canal Company, and others, against the Manchester, Sheffield, and Lincolnshire Railway Bill; by the Mersey Docks and Harbour Board, the North-Western Railway Company, and the Corporation of Liverpool, against the Manchester Ship Canal Bill; by the North-Western, against the Marple Gas and Marple Local Board Gas Bills. Petitions have also been presented against the Oldham Corporation Bill, the St. Helen's and Wigan Junction Railway Bill, the Salford Corporation Bill, and the West Durham and Tyne Railway Bill.

Having passed the Examiner, the following Bills have been read a first and a second time in one or the other House:—Accrington, Clitheroe, and Sabden Railway Bill, Ashton-under-Lyne Improvement Bill, Belfast Main Drainage Bill, Carlisle Corporation Bill, Guildford Corporation Bill, Harrow and Stanmore Railway Bill, Highgate and Kilburn Open Spaces Bill, Kirkcaldy and Dysart Water Bill, Lea River Purification Bill, Listowel and Ballybunion Railway Bill, Liverpool Corporation Bill, Loughborough Local Board Bill, Marple Local Board Gas Bill, Metropolitan Board of Works Bill, Metropolitan Markets Bill, Nelson Local Board Bill, Nottingham Suburban Bill, Oldham Corporation Bill, Ormskirk Railway Bill, Ripon Corporation Bill, Salford Corporation Bill, Sidmouth Water Bill, Torquay Harbour and District Bill, West Durham and Tyne Railway Bill, Barry and Cadoxton Gas and Water Bill; Bray and Enniskerry Light Railway Bill; Brighton Corporation (Loans, &c.) Bill; Brighton, Rottingdean, and Newhaven Direct Railway Bill; Bristol Corporation (Docks) Bill; Bristol (Totterdown-bridge) Bill; Bute Docks (Cardiff) Further Powers Bill; Bute Docks (Cardiff) Transfer Bill; Edinburgh Improvement Bill; Edinburgh University Buildings Extension Bill; Falkirk Water and Drainage Bill; Kensington Vestry Bill; Lancashire County Justices Bill; Leamington Corporation Bill; Lloyd's Bill; Morecambe Tramways Bill; and Neath Harbour Bill; Whitehaven Harbour and Docks Bill; the Alliance British and Foreign Life and Fire Assurance Company Bill; Ardrossan Gas and Water Bill; East and West India Dock Company Bill; Girvan and Portpatrick Junction Railway Bill; Rhondda and Swansea Bay Railway Bill; Scottish Union and National Insurance Company Bill; Southampton Docks Bill; and Taff Vale Railway Bill. The Standing Orders Committee have reported a number of non-compliances with the Standing Orders, and while they have advised that the Standing Orders should be dispensed with in the case of the Plymouth, Devonport, and District Tramways Bill, and the Mersey Railway Bill, they recommend the contrary course with regard to the Liverpool and Birkenhead Subway Bill; and the Felixstowe, Ipswich, and Midlands Railway Bill.

Admiral Egerton, Mr. Blake, Mr. Burke, Sir Julian Goldsmid, Sir J. Kennaway, Mr. Ernest Noel, Sir John Ramsden, and Sir H. Selwyn-Ibbetson have been appointed a General Committee on Railway and Canal Bills.

Mr. Channing, supported by Mr. J. Leicester, Mr. J. Wilson, Mr. C. S. Parker, Mr. Lawson, and Mr. Jacoby, has introduced a Bill which proposes to extend the powers of the Board of Trade in the direction of compelling the adoption of safety appliances, and other arrangements for preventing loss of life on railways, and to render it compulsory on railway companies to make a monthly return of men who are at work for more than twelve hours at a stretch out of the twenty-four.

There is likely to be a vigorous contest over the Bill for purifying the River Lea, unless the Metropolitan Board of Works and other bodies at present opposed to the measure consent to modify their attitude. As a preliminary skirmish a large public meeting has been held to strengthen the hands of the Hackney Board of Works, who are promoting the scheme, the Attorney-General and some other members of Parliament taking part in the demonstration. The Attorney-General explained that with a view to remedying the present disgraceful state of things, the Hackney Board were promoting this Bill in order to obtain power to construct a sewer to effect a junction between their sewer at Spring Hall and another sewer by which the effluent from the Tottenham sewage works would be carried into the sewer under the jurisdiction of the Metropolitan Board of Works near Old Ford. Opposition came, and came with a bad grace, from Tottenham, and the scheme was also opposed by the Metropolitan Board of Works, though the Bill gave power to the latter body to exercise a controlling force as to the times when the effluent should be admitted into their sewer. It was resolved by the meeting to support the Hackney Board, to endeavour to induce the two opponents referred to to reconsider their opposition, and to form a guarantee fund to indemnify the promoters. In connection with this subject, it is interesting to note that Mr. Hastings had introduced a Bill into the House of Commons for the purifying of rivers generally.

It would seem that the Corporation have decided to proceed with the Tower Bridge as authorised last session, for it was stated at the last Court of Common Council that the engineer was well forward with the plans, specifications, working drawings, &c., and hoped soon to commence the work of construction. The first pile is expected to be driven on the Queen's Birthday, May 24th. While these steps are being taken for providing a new bridge across the Thames, the Board of Works are being urged to establish additional means of communication lower down the river, between Poplar and Greenwich, either in the form of a subway or a ferry.

LETTERS TO THE EDITOR.

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

THE PECULIARITIES OF STEEL.

SIR,—In your issue of December 11th, 1885, Mr. Maguinness describes the extraordinary behaviour of the steel plates of which a number of marine boilers were made. Of course, this is most interesting and important, and calls out many recitals of experience and many hypotheses to throw light upon the matter. The account which Mr. W. Parker gave some time back of the remarkable behaviour of some thick steel boiler plates was no exception in this respect. There is one probable cause of queer behaviour to which I have seen no reference either in your columns or elsewhere, viz., the effect of a one-sided or non-axial stress upon a plate of steel.

In order to more clearly explain this effect, I will give an account of my experience—as inspector for Dr. E. D. Levitt and Co.—with some open hearth steel plates for a boiler of the locomotive type, having a diameter of shell of 90in., a heating surface of 2800 square feet, and a grate area of 64 square feet, to work with a pressure of 135 lb. above the atmosphere. A competitive test was being made of steel furnished by two makers, the plates being $\frac{9}{16}$in. and $\frac{3}{8}$in. in thickness. The steel itself was tested, and all of its important physical qualities noted, and then the remainder of the plates made up into a number of boiler joints. The test piece cut from each plate was 34in. long, 8in. wide at the ends, and reduced to a finished width of 5$\frac{5}{8}$in. for a midlength of 24in. The qualities of the steel as brought out by the Emery testing machine at Watertown, Mass., were as follows:—

	Steel A. $\frac{9}{16}$in. thick.	Steel B $\frac{9}{16}$in. thick.
Section of specimen	5·61″ × ·561″ = 3·147 sq. in.	5·595″ × ·568″ = 3·18 sq.in.
Elastic limit	31,141 lb. per square in.	30,191 lb. per square in.
Ultimate strength ..	59,056 lb. ,,	62,924 lb. ,,
Elongation in 10in...	31$\frac{8}{10}$ per cent.	31$\frac{7}{10}$ per cent.
Contraction of area..	56 ,,	43 ,,
Appear'ce of fracture	Fine silky.	Fine silky.

	Steel A. $\frac{3}{8}$in. thick.	Steel B. $\frac{3}{8}$in. thick.
Section of specimen	5·615″ × 0·377″ = 2·117 sq in.	5·605″ × 0·381″ = 2·136 s.in
Elastic limit	37,317 lb. per square in.	33,708 lb. per square in.
Ultimate strength ..	59,669 lb. ,,	63,314 lb. ,,
Elongation in 10in. ..	32 per cent.	29 per cent.
Contraction of area..	52 ,,	47 ,,
Appear'ce of fracture	Silky with minute laminations.	Silky laminated.
Remarks	Very magnetic at fracture.	

Among twelve joints made from these plates was a butt joint of $\frac{9}{16}$in. A plate with a $\frac{9}{16}$in. covering plate on one side and a $\frac{3}{8}$in. covering plate on the other, the latter extending sufficiently beyond the former to permit three rows of rivets, with rapidly increasing pitch, to pass through it and the main plate, while it—the main plate—and the thicker covering plate were double rivetted on each side of the centre of the joint. There were thus ten rows of rivets in the joint, and its width was 15$\frac{5}{8}$in. The length of the specimen was 5ft., and it broke at 450,000 lb. pull. The fracture was across the main plate through the outer row of rivets—of greatest pitch—was granular, like close grained cast iron, was scarcely reduced in area, and was accompanied by a loud report. In the fractured end, however, there were two spots about $\frac{3}{8}$in. in diameter, which showed a fine silky fracture, and made an effort to contract. By referring to the preceding table it will be seen that the steel—A—of which the joint was made showed excellent qualities when tested, and to account for its behaviour in the joint was difficult. It was observed, however, that although the holes were all drilled and slightly countersunk with the plates in place, one of the remote side rivets sheared some time before the joint broke, and this suggested to Mr. Howard, in charge of the testing machine—who had seen similar phenomena—that the character of the break was due to a non-axial pull. To see whether this might be so, a strip of plate was cut adjacent, and at right angles to, the fracture, with the following results:—

Cross-section of specimen 1·5in. × 0·543in. = 0·81 square inch.
Ultimate strength per square inch, 64,750 lb.
Elongation in 10in., 15 per cent.
Contraction of area, 54 per cent.
Appearance of fracture, fine, silky.
Fracture, noiseless.

In considering the high ultimate strength and low elongation in this list, it must be remembered that the specimen had passed its elastic limit, and contracted and stretched somewhat when in the joint.

Since having had this bit of experience, it has often occurred to me that mysterious failures of steel plates might be accounted for in a similar manner to this.

American engineers are often struck with the small part which the elastic limit of material plays in discussions among English steel producers and consumers. Many of our leading engineers consider that a high elastic limit, when combined with a moderate ultimate strength, great elongation, and contraction of the fractured section, is the most important quality which steel can possess. When the qualities enumerated are combined, the high elastic limit is the result of excellence of material and intelligence in manipulation, and not of high carbon, an increase of which can easily raise the elastic limit. Hundreds of tests of large specimens of open hearth plate have convinced me that elastic limit and ultimate strength are in no way dependent on each other, and as steel is useless after its elastic limit is passed, it seems to be of doubtful propriety to specify any ultimate strength in particular.

In partial support of these statements and views, I have given the particulars of specimens rather fully, and below give some general results of tests of the twelve joints previously referred to, of various designs, six being made of plate A and six of plate B in pairs, each member of a pair being an exact duplicate of the other as near as possible. All edges of plates were planed and nicely finished, all holes were accurately spaced, drilled in place, countersunk slightly, and the rivets were closed by a steam machine.

Table showing the Efficiency of certain Rivetted Joints in comparison with the Strength of the Solid Plates.

	Steel A.		Steel B.	
No. of joints.	Thickness of plate.	Efficiency of joint.	Thickness of plate.	Efficiency of joint.
1	$\frac{3}{8}$in.	52 per cent.	$\frac{3}{8}$in.	42 per cent.
2	$\frac{9}{16}$in.	54 per cent.	$\frac{9}{16}$in.	48 per cent.
3	$\frac{9}{16}$in.	72 per cent.	$\frac{9}{16}$in.	70 per cent.
4	$\frac{9}{16}$in. and $\frac{3}{8}$in.	75 per cent.	$\frac{9}{16}$in. and $\frac{3}{8}$in.	73 per cent.
5	$\frac{9}{16}$in. and $\frac{3}{8}$in.	87$\frac{4}{10}$ per cent.	$\frac{9}{16}$in. and $\frac{3}{8}$in.	83 per cent.
6	$\frac{9}{16}$in.	63 per cent.	$\frac{9}{16}$in.	59 per cent.

Some of the joints were not designed for strength, but to prevent leaking. Referring back to the qualities of the material, it will be seen that the plates having the lowest ultimate strength, the highest elastic limit, the greatest elongation and contraction of area always gave the most efficient joint.

Now, the obvious explanation of these results is that the more ductile steel more perfectly fitted around and bore upon the rivets after the joints were in considerable tension, and the higher elastic limit allowed this to go on for a longer time than in the case of the lower.

If the high elastic limit, when combined with other desirable qualities, is as advantageous as it seems to be, it is fortunate that it can be so much increased by prolonged manipulation. It is perfectly possible to get unlimited quantities of $\frac{9}{16}$in. steel plates with an elastic limit of 40,000 lb. per square inch in tension, with an ultimate strength of 53,000 lb. to 63,000 lb. per square inch, a contraction of area of 45 per cent., and an elongation of 22 per cent. in 15in.; while if this same plate were further rolled to a thickness of $\frac{3}{8}$in., its elastic limit would increase to 46,000 lb., its ultimate would remain stationary, its contraction would slightly increase, and its elongation would remain unchanged.

Such results, of course, point to the advantage of thick ingots, and they have sometimes been specified to be a certain number of times the thickness of the finished plate. Such specifications are, I believe, carried out by Mr. F. W. Webb, at the Crewe Works. Results are excellent when the ingot is twenty-five times the thickness of the plate.

It would be very interesting if the influence of the elastic limit of steel could be investigated in connection with rivetted joints, and I would suggest that it be noted in the experiments which Professor Kennedy has in charge for the Committee of Research of the Institution of Mechanical Engineers. I have had some reason to think that the elastic limit influences the slipping of joints; but as this depends upon so many conditions, and as my results are not altogether harmonious, I forbear placing them before the public.

F. W. DEAN,
Member American Society of Mechanical Engineers.
604, Main-street, Cambridge, Mass, February, 1886.

PILE DRIVING.

SIR,—"Scrutator" must be endowed with a superabundance of self-complacency, or he would not have ventured to reproach you for allowing full scope to "Φ. Π." and myself for the discussion of inertia and momentum, and to ask you at the same time to devote nearly half a column of your valuable space to the sorriest rubbish I have seen written on the question of pile driving. I am quite sure that the previous discussion must have shed some rays of light in a region of intense darkness.

What does "Scrutator" mean by saying that there is "no maximum momentum" the pile will bear? The sentence is simply unintelligible. Does he mean that there is no limit to the momentum a pile will bear? If "Scrutator" were responsible for the successful construction of a permanent structure resting on 12in. piles standing 16ft. out of the ground, would he allow the pile drivers to drop a 2-ton monkey upon the pile from a height of 4ft., or a 1-ton monkey from a height of 16ft.? The momentum at the instant of impact would in each case be the same. If "Scrutator" would not do this, it is clear there must be in his estimation a limiting value of the momentum which a pile will bear—of course the same momenta have very different effects. The mass of the falling body may be too small to produce any appreciable motion in the pile, the whole force of the momentum being expended in either shattering or penetrating the head of the pile. But these small masses are excluded from the scope of the discussion, since we are dealing with the effect of the impact of a monkey on a pile of sufficient weight to produce motion in the pile. I shall be glad to hear from "Scrutator" whether the momentum of a 10 cwt. monkey falling a height of 4ft. would cause greater, equal, or less strain on a pile acting as a pillar, than that of a 5-cwt. monkey falling 16ft. The momentum at the instant of impact is in each case the same. Perhaps also "Scrutator" would not object to give your readers the calculations on the result of which his opinion is based.

Does "Scrutator," then, think I am in error in stating—I did not assume it to be so—that $W\sqrt{\frac{2H}{g}}$ is equal to the mass multiplied by the velocity? Does he really mean to assert that the equation $mv = W\sqrt{\frac{2H}{g}}$ is incorrect? If correct, what interpretation does "Scrutator" himself put upon the statement of the equating of the momentum to a weight?

As explained in my last letter, in answer to "Φ. Π.," I inadvertently used initial for maximum. I frankly acknowledge that I committed an absurd mistake in suggesting that the momentum of the pile might be set against the downward moving force of the pile. The former is expended in overcoming the resistance of the substance into which the pile is being driven, and, therefore, acts in conjunction with, and not in opposition to, the moving force exerted by the weight of the pile.

In solving the problem, the elastic reactions referred to by "Scrutator" must, of course, be taken into account. How is this to be done? Dr. Whewell has investigated this question in his work on "Mechanics," on assumptions which may or may not be wholly correct, but he has not made the slightest reference to the problem which I submitted to your readers, viz., What is the maximum momentum which a pile of given section, given length, and given material will support as a pillar without sustaining permanent injury? Piles are, as matter of experience, known to be sometimes permanently injured in driving, and there are doubtless many piles left in permanent structures which have sustained permanent injury, but not of sufficient extent to enable the injury to be detected.

"Scrutator," in conclusion, states that he had expected to lay this before your readers much more briefly. What is the "this" he has laid before your readers? Is it not like the initial momentum of the pile—zero? WILLIAM DONALDSON.

2, Westminster-chambers, February 16th.

FREE TRADE AND NO TRADE.

SIR,—I fear that "M. H. R." does not read what I write with sufficient care. If he had done so he would understand that his last letter leaves quite untouched the substance of my argument. He seems, indeed, to think that I believe that huge sums of English gold go out of this country and never return to it. I have never said anything of the kind. I do say now that gold is very often drained out of this country, and that to stop this drain the Bank of England has to take special precautions. I have, however, used the word gold in the larger sense of money, as well as the smaller one of a precious metal. "M. H. R." knows, no doubt, as well as I do how divided political economists are concerning the part which gold plays in regulating the commercial prosperity of a country, and I have no intention of following your correspondent into a discussion of the kind. If it will simplify matters, I am willing to concede for the sake of argument that not a sovereign ever finds its way from this country to any other. My propositions are entirely independent of the gold question. Let me state them once more:—

(1) That country must be on the whole best off, the population of which is most fully employed. (2) Protection encourages the employment of the population of the protected country.

"M. H. R." does not dispute the soundness of the first proposition. To the second he takes exception, because, he says, with Free Trade our imports will be the largest possible; and as the imports must be paid for by goods exported, the amount of the imports of a country is the measure of its exports, and consequently of the volume of employment at the disposal of the population. Near the end of his letter, however, your correspondent says:—"Interwoven with these assertions and hints, and suffering from the intermixture, is a line of argument—as I will admit it to be until I am able to examine it—directed to show that a protective tariff would give more work to our people, and that they are injured by the investment of British capital abroad. These matters on their own merits are well worth discussing, and if 'Trader' will consent to separate his two issues, I shall be glad to discuss things further with him." From this I gather that he is at least open to conviction concerning the merits of my second proposition. I am quite willing to discuss it with him on his own terms as far as possible.

Before doing this, however, it seems to me to be essential that we should clear the ground and have some definite basis on which to work. I do not pretend to understand the mysteries of political economy. As I have said already, I am neither a Protectionist, nor a Fair-Trader, nor a Free Trader. I am endeavouring to search out and find what is really most likely to be of use to England in her present distress. I know that there are thousands and thousands of men walking about idle simply because no employment can be had for them. I cannot find that anything at all analogous to this exists on the continent of Europe; and I also know that one of the reasons why our men are idle and Germans, French, and Belgians are at work, is that these countries, instead of employing us to make things for them, are making what they want for themselves; and it is not an unnatural conclusion to draw, that if we did not employ foreigners to make things for us we must employ our own population in making them. Against this it is argued that it makes no manner of difference whether we import things or not; our working classes are employed all the same. To this I answer that the Board of Trade returns show that our imports far outweigh our exports in value, and then I am told that this a delusion. Very well, let us try and clear this point up before we go any further.

I showed that in 1884 we imported goods to the value of £78,000,000 from certain countries, and exported goods to the value of £33,000,000 to the same countries. That is to say, we made a gross profit of no less than £45,000,000, according to "W. A. S. B." and "M. H. R.," or in other words, no less than 136 per cent.! Now, I want to know how this profit was made. Your correspondents tell me that freight made up a large part of it, and that as this freight was carried by British ships it shows so much gain to the country. No sane man will venture to go so far as to say that England had to pay £45,000,000 for carrying £33,000,000 worth of goods for an average distance of probably 300 miles. Considering what freights are, I fancy I shall be over the mark if I say that £2,000,000 went to the shipowners. How are the remaining £43,000,000 made up?

The goods imported are, I understand, valued as they are landed and before they reach the consumer. That is to say, the wholesale price is given in the returns. Now, am I to understand that what the merchant paid £33,000,000 for can be sold wholesale in this country for £78,000,000? or that, deducting the cost of carriage and insurance from the Continent of Europe to London, Liverpool, Hull, &c., the English importer actually realises the stupendous profit of 120 per cent., or thereabouts? Such a statement is simply incredible. Does your correspondent fancy that he could import 1000 tons of sugar from Belgium, and make 120 per cent. on the transaction, selling the sugar wholesale in the London docks? Could he bring over a cargo of girders from Belgium and make such a profit? Can he put his finger on a single article in general demand on which such a profit, or any profit over 20 per cent., could be made? I do not know whether your correspondent is or is not in the trade. I gather from his letter that he is not. But he must be able to make inquiries from some one who is, and I challenge him to bring forward the testimony of a single witness that a profit can be made in a legitimate way of 120 per cent., by simply transferring goods from one side of the Channel to the other. If such a thing could really be done, the Channel would be more crowded with steamers than Thames-street is with vehicles. The harbour accommodation at both sides would be entirely inadequate to the demand made on it. Such an explanation must be abandoned, and some other must be sought.

Am I to assume that the declared value of the goods we import is their retail value? If so, it is quite certain that we did not get from the foreigner £78,000,000 worth of goods. It is out of the question that the foreigner should be credited with the cost of internal distribution. If I buy a steam engine, and pay £300 for it to the maker and £30 to a railway company for carriage, I certainly cannot say that I have had £330 worth from the maker.

In point of fact, no one seems to know what such figures as these I have quoted really mean. I do not know what they mean if they do not imply that we exported goods which we sold for £33,000,000, and that we imported goods for which we paid £78,000,000, less carriage and, say, 10 per cent. profit made by the importer. Your correspondent, "Iron," seems to think that 20 per cent. is sufficient to cover freight and profit each way, or 40 per cent. in all; but this would mean that for our £33,000,000 exported we received £46,300,000 only, instead of £78,000,000.

Until, as I have already said, this point is cleared up, it will be waste of paper and time to go further. Perhaps some of your correspondents can tell me, assuming that "M. H. R." cannot, what the Board of Trade figures really mean. If they mean what they profess, then I say that we are buying enormously abroad goods which ought to be made at home. If they mean something else, then they are entirely delusive to the great body of traders in this country.

I have waived the gold question, in deference to your correspondent's wishes. Will he in return confine his attentions to explaining what is the meaning of the statement that 33,000,000 of pounds worth of goods exported sufficed to buy 78,000,000 of pounds worth of goods imported? TRADER.

London, February 23rd.

SIR,—I have read the very able letters of "M. H. R." on this subject with much pleasure, and I hope he will understand that in putting the following question I have no intention of casting doubt on his contentions.

Question: Can "M. H. R." or anyone else give us statistics relating to the export and import of interest-bearing securities, such as stocks, shares, bonds, and mortgages?

I have searched for information on this point for years in vain. I do not think that any statistics exist, but till they do it is vain to say that our trade returns are complete; and "M. H. R.'s" demonstration that we do not pay for our excess imports in gold will do little to end the present discussion unless he can also show that we do not pay for them by the export of interest-bearing securities. WM. MUIR.

London Institution, Finsbury-circus, February 20th.

SHIPBUILDING IN THE NORTH.

SIR,—In your issue of this week, in the statistics given of shipbuilding during 1885, the compiler, in making a comparison between the North-East ports and the Clyde, endeavours to make them equal by excluding West Hartlepool from the North-East ports, although in the same calculation he includes the Tees. Now, the fact is that in character of vessels built, and in both employers and men belonging to the same associations, which are independent of the Tyne and Wear associations, West Hartlepool and the Tees form one group, and, as you are aware, West Hartlepool is geographically also to be classed with the Tees, being just outside its mouth. So that there is no reason why the West Hartlepool tonnage should be excluded in the total tonnage of the North-East ports in making a comparison with the Clyde; and when this is done, it is, as you say, plain that the tonnage of the North-East district overtops that of the Clyde. It is usual also to include Whitby in the North-East ports, but very little has been done there during the past year.

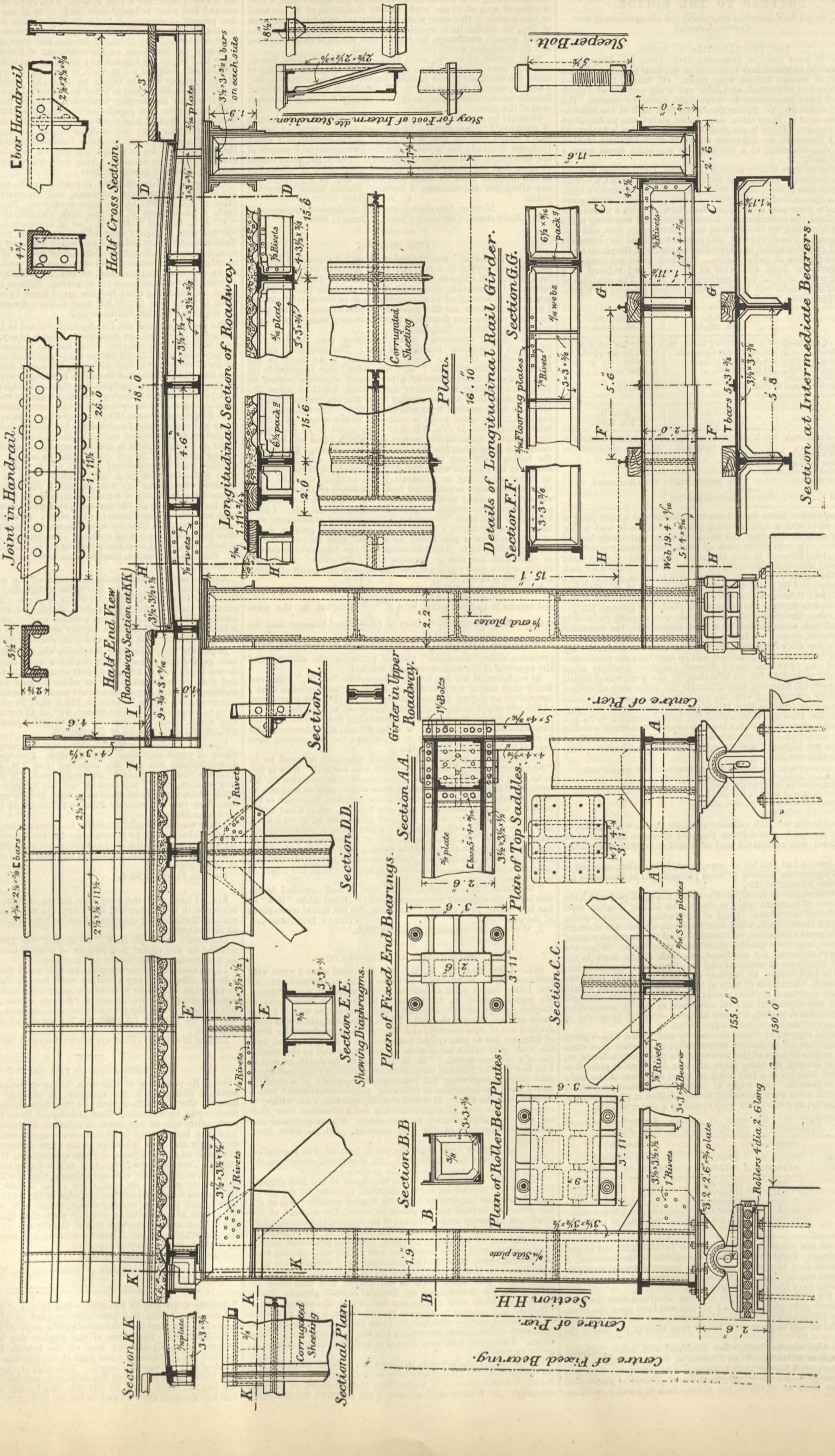
West Hartlepool, February 23rd. G. H. B.

[*For continuation of Letters see page 173.*]

TRADE WITH RIO DE JANEIRO.—The entries of foreign shipping at Rio de Janeiro last year gave a total of 1263 vessels and 1,323,965 tons, and the clearances gave a total of 1105 vessels and 1,283,264 tons. The share of the English flag was 463 vessels entered and 437 cleared; that of the French flag 114 vessels entered and 119 cleared; and that of the German flag 140 vessels entered and 117 vessels cleared. The total of the coasting trade was 1399 vessels entered at Rio de Janeiro and 1580 vessels cleared, the English share being 93 and 121, the French share 30 and 27, and the German share 56 and 76 vessels respectively.

LATTICE BRIDGE OVER THE SUTLEJ.

(For description see page 172.)



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CONTENTS.

THE ENGINEER, February 26th, 1886.

TO CORRESPONDENTS.

Registered Telegraphic Address—"ENGINEER NEWSPAPER, LONDON."

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

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

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

D. J. M.—*It cannot be obtained in London.*

WORSTED CARDING MACHINERY.—*Letters on this subject await the application of our correspondent.*

SQUIRE.—*Yes, provided all preparations have been made, and there is no delay in obtaining materials.*

G. H.—*A good clean Cornish boiler will evaporate about* 6½ *lb. or* 7 *lb. of water per pound of engine slack.*

ALUMINIUM FOIL AND LEAF (J. S.).—*Messrs. Wright and Bull, of* 3, *Great Charles-street, Birmingham, are makers.*

W. T.—*It is impossible to give a precise answer to such a question. Under favourable conditions a tramcar might be driven three or four miles.*

A READER.—*The engine will lift three times the load if you put the drum on the counter shaft, less a small amount, say* 10 *per cent., to be deducted for friction; but it will lift the load at only one-third of the speed.*

CORROSION.—*There are two reports. You can possibly obtain them for a trifle by advertising for them. If you do not like to take this course, apply to Messrs. Hansard, Great Queen-street, Parliamentary publishers. The price is, we believe, about* £2.

M. D.—(1) *When the spring is quite flat the distance between the ends will be the length of the top leaf. The simplest way to ascertain the distance for any other range of spring is to set the top leaf out graphically, or to take a lath of the proper length and bend it to various curves.* (2) *The weight of the spring is found by calculating the number of square feet of metal in it, and allowing* 40 *lb. for every square foot* 1in. *thick.* (3) *There is no rule of the kind because the expression has no meaning.*

TEMPERING STEEL CASTINGS.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers inform me if steel castings can be tempered, and, if so, by what process? J. C.

Glasgow, February 18th.

HOFFMAN'S STEEL RAIL.

(*To the Editor of The Engineer.*)

SIR,—I shall feel obliged if any of your correspondents can give me the name and address of the manufacturer of Hoffman's patent angular steel rail, and also the manufacturer of rolling machines for rolling sheep troughs. NEMO.

Lincoln, February 22nd.

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Friday, Feb. 26th, at 7.30 p.m.: Students' meeting. Paper to be read, "Stability of Voussoir Arches," by Mr. Henry A. Cutler, Stud. Inst. C.E. Mr. William Henry Barlow, F.R.S., Past-President Inst. C.E., in the chair. Tuesday, March 2nd, at 8 p.m.: Ordinary meeting. Paper to be further discussed, "The River Seine," by Mr. L. F. Vernon-Harcourt, M.A., M. Inst. C.E.

SOCIETY OF ENGINEERS.—On Monday, March 1st, at the Town Hall, Caxton-street, Westminster, at 7.30 p.m., a paper will be read "On the Roorkee Hydraulic Experiments," by Mr. E. S. Bellasis, A.M. Inst. C.E., of which the following is a synopsis:—Method of velocity-measurement adopted at Roorkee - double-float error—method of designing a double-float—results by velocity rods—current meters generally best—ratio of different velocities in cross section is independent of actual velocities; and, in a rectangular channel, independent of the depth of water—laws of the variation of the coefficients for obtaining the mean velocity from the central velocity—Bazin's and Prony's coefficients unreliable—Kutter's coefficient justified.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—The general meeting will be held in the Lecture Hall of the Literary and Philosophical Society, Newcastle-upon-Tyne, on Wednesday, March 3rd, at 7.45 p.m., when the following paper will be read:—"Forced Draught," by Messrs. Patterson and Sandison.

PARKES MUSEUM OF HYGIENE, 74A, Margaret-street, Regent-street, W.—Thursday, March 4th, at 8 p m.: Lecture by Mr. Shirley Murphy "On Metropolitan Defence Against Infectious Diseases."

CHEMICAL SOCIETY.—Thursday, March 4th, at 8 p.m.: Ballot for the election of Fellows—important. Papers to be read: "On the Influence of Temperature on the Heat of Chemical Combinations," by Mr. S. U. Pickering. "The Action of Heat on the Salts of Tetrethylphosponium," by Mr. N. Collie. "On a New Method for the Preparation of Tin Tetrethyl," by Dr. Letts and Mr. N. Collie. "Contribution to the History of Cyanuric Chloride and Cyanuric Acid," by Mr. Alfred Senior, M.D. "Contributions to the Knowledge of Cyanuric Derivatives," by Mr. Harold Fries.

SOCIETY OF CHEMICAL INDUSTRY.—London Section: Chemical Society's Rooms, Burlington House.—Monday, March 1st, at 8 p.m.: Papers to be read, "On Viscosimetry," by Mr. Boverton Redwood, F.C.S., F.I.C. "On Ice Making and Cooling Machinery," by Mr. T. B. Lightfoot, M.I.C.E., M.I.M.E.

SOCIETY OF ARTS, John-street, Adelphi, London, W.C.—Monday, March 1st, at 8 p.m.: Cantor Lectures. "Science Teaching," by Professor F. Guthrie, F.R.S. Lecture III.—Teaching physics. Tuesday, March 2nd, at 8 p.m.: Foreign and Colonial Section. "Bechuanaland and Austral Africa," by Mr. John Mackenzie, late Deputy Commissioner of Bechuanaland. Sir Henry Barkly, K.C.B., F.R.S., G.C.M.G., will preside. Wednesday, March 3rd, at 8 p.m.: Thirteenth ordinary meeting. "Calculating Machines," by Mr. C. V. Boys.

THE ENGINEER.

FEBRUARY 26, 1886.

PROFESSOR HUGHES' LATEST DISCOVERIES.

THE scientific world has of late years grown so accustomed to see Professor Hughes bring forward one important discovery after another, that it desires more and more, almost as a matter of course. Whenever a fitting opportunity offers, he is expected to improve it by laying before the world some new theory which is the outcome of last year's patient experimental investigation; and this expectation has been fully realised in his inaugural address to the Society of Telegraph Engineers and Electricians. To a physicist of the old school, accustomed to the elaborate, complicated, and highly-finished instruments which crowd the laboratories of our Universities, the simplicity of the apparatus employed by Professor Hughes must seem almost child-like. A few bits of wire and strips of metal, some coils, a telephone, a magnet or two, and similar things, constitute all that he requires. Yet in spite of this great simplicity in the tools, the work he turns out is of immense importance.

It has long been known that if an electric current flowing through a closed circuit be suddenly interrupted, an electro-motive force is created between the severed ends of the circuit, tending to continue the current in the same direction. The extra current thus set up prolongs the original current; and on the other hand, if a circuit previously opened be closed, the extra current retards the flow of electricity. Electricians comprise these phenomena under the term self-induction, and hitherto it was believed that the self-induction depends only on the length and shape of the circuit, but, with one exception, not on the material of which it is composed. The one exception is iron, which offers more self-induction than the non-magnetic metals. The practical importance of the question of self-induction will be realised when it is considered that the retardation of an incipient current, and the prolongation of a current after it is supposed to be stopped, both tend to reduce the speed with which telegraphic signals can be sent; also that in the case of lightning conductors the counter electro-motive force created by self-induction may in some cases diminish the carrying capacity of the rod so much as to render it almost useless as a protector. Professor Hughes has set himself the task of experimentally investigating the self-induction in different conductors, and for this purpose he invented an instrument which he calls the induction bridge. It is a simple resistance bridge, with the addition of two fine wire coils, one inside the other, and a telephone instead of a galvanometer. The inner coil can swivel within the outer one, so that the planes of the two coils can form any angle between 0 deg. and 90 deg., the exact position being indicated by a pointer. If the coils are at right angles, and the current in the outer coil is rapidly made and broken, no currents are induced in the inner coil, and no sound is heard in the telephone which is connected with it. If the inner coil is set at any angle between 90 deg. and 0 deg., a sound is heard in the telephone, and this is the louder the more acute the angle. If, on the other hand, the telephone circuit contains a source of electro-motive force, such, for instance, as a wire having more or less self-induction, a sound will be heard if the coils stand at 90 deg., and by turning the pointer to one side or the other of the rectangular position the sound can be made to vanish. In this case the induction in the coils—or sonometer, as Professor Hughes calls this part of his induction bridge—exactly counterbalances the effect of self-induction in the sample of wire under test, and the angular position of the internal coil, as indicated by the pointer, is a measure of this self-induction.

Now the first achievement of this simple little instrument seems to have been to completely break down the old-established theory that all non-magnetic metals are alike in point of self-induction. It was found that there is a considerable difference in the self-induction between different metals, lead, for instance, showing only half as much as, and mercury only a tenth part of the self-induction of copper. The next discovery made by the aid of the induction bridge was that relating to the influence of the form of the conductor. It appears that round solid wires, flat strips and stranded cables, all behave very differently, the former offering the greatest self-induction, and being therefore the worst possible form in which a given weight of metal can be used. To quote Professor Hughes' own words:—"Let us assume that an electric current consists of a bundle or an almost infinite number of parallel currents, the limit being a single line of consecutive molecules; then each line of current should, by its electro-magnetic action, react on each of the others similarly to wires conveying separate portions of the current, and the self-induction should be at its maximum when the lines are in the closest possible proximity, as in a conductor of circular section, and far less when separated, as in one of ribbon form, where the outlaying portions are separated by a comparatively great distance; there would still remain, in the latter case, the reactions from the near portions on each other, and these should again be reduced by cutting the ribbon into a number of thin narrow strips, separated, except at their junctions, to a sufficient distance to prevent any marked reaction." From tables which were given by Professor Hughes, it appears that the nature of the metal has less influence on self-induction than the particular form given to the conductor, and it is thus possible to reduce the inductive capacity of a stranded iron or steel wire rope to that, and even below that of a solid copper wire of equal electrical resistance. A 36-strand iron wire has only 5 per cent. of the inductive capacity of a solid iron wire of the same weight, and the importance of this fact in telegraphy was during the discussion prominently brought to light by Mr. Pope, who related that in the very early days of telegraphy in America he noticed that on a line where instead of a solid wire a thin stranded cable was used, the speed of signalling was always far greater than on the ordinary lines. In those days nothing was known of self-induction, and telegraph engineers attempted to explain this peculiarity of stranded conductors by the theory that electricity travelled preferably on the surface of the conductor, which in this case was of course considerably greater than in a solid wire of the same weight.

We think Professor Hughes' discoveries should induce cable companies to perceive that the time-honoured system of surrounding the conductor of a submarine cable by a protecting sheathing of twisted iron wires is electrically the very worst possible arrangement. Iron, by its magnetic properties, increases enormously the self-induction of the copper core, and therefore decreases the speed of signalling. When the first cables were laid there was some excuse for employing iron and steel for the purpose of protecting submarine cables, because no other non-magnetic metal was known which had sufficient tensile strength. But now-a-days, when there is a large number of bronzes obtainable, most of them nearly equal, and some quite equal to best steel in tensile strength, there is no reason why the practice of surrounding cables with a magnetic envelope should be continued. Another valuable lesson to be learned from the experiments above mentioned refers to lightning conductors. If a solid wire offers by its self-induction twenty times as much resistance to the incipient current as a stranded cable of equal cross sectional area, then the facility to conduct quickly to earth a lightning discharge is in the latter case so much greater than in the former, that solid rods should never be used. It is a curious fact that popular opinion has for years been in favour of flat strips instead of solid rods for lightning conductors. In the absence of any scientific reason for such an opinion, we would certainly have considered this a case of popular superstition, like many others; but now Professor Hughes' experiments have shown that there is actually good scientific reason for an opinion which, far from being merely a superstition, was rather a manifestation of the popular scientific instinct backed by experience.

THE BEHAVIOUR OF STEEL.

THE question as to the cause of the failures of steel boiler plates, apparently with no stress upon them, or with a stress far short of their estimated ultimate strength, is at the present time creating great interest in engineering circles. It has recently been suggested that the working of steel at a blue heat, that is at a temperature below redness, say from 470 deg. to 600 deg. Fah., may have been the cause of some failures. It is a noteworthy fact that most of the plates which have up to the present time failed in this manner have been previously worked in the fire, and this to some extent bears out the theory in question, by providing the probability that at least some portion of the plate was worked at this temperature. It has long been known that there is a certain amount of danger incurred in working mild steel at blue heat, as it has been found that at these temperatures it certainly loses some of its ductility, and in the best yards and workshops steel has for a long time been worked either red hot or cold; but at the same time it has generally been considered that, if the steel successfully withstood the ordeal of working at the blue heat, it was uninjured when it became cold, and that it retained the same good qualities as if it had been worked into its place red-hot. It now appears that this is not the case, but that, at least with certain qualities of steel, the ductility existing when cold is reduced by such treatment; the alteration of ductility of course depending to some extent upon the amount of working put upon the plate when at a blue heat.

A favourite explanation of the so-called mysterious cracks sometimes occurring in worked plates has been that local heating during working sets up internal stresses by the expansion and contraction of the material, in a somewhat similar manner to that in which such stresses are produced in castings. The portions locally heated become expanded when hot, and as they are bound, as it were, by the neighbouring cooler portions, and not able to lengthen, and being at the same time comparatively soft, they become upset. When these portions cool down they tend to contract, but being still bound by their neighbouring portions they cannot shorten, and as they are then harder and stronger than they were when hot, they become stretched, or in other words, are put in tension with an equal amount of stress to that which would be required to produce an elongation equal to that which is caused by the contraction being prevented. It is in order to relieve stresses thus produced that recourse is had to annealing, which by raising all parts to a uniform red heat allows the strained parts to stretch or compress themselves sufficiently to relieve the stresses upon them while the metal is soft. The subsequent uniform cooling then leaves all portions without strain. This argument, however, only holds good for the production of initial stresses up to the amount which would cause an elongation equal to that imposed by the contraction of the parts; that is to say, practically the stresses so produced cannot much exceed the elastic limit, and as the ultimate elongation before rupture is over 20 per cent. it is difficult to see, if the material is perfectly homogeneous, how stresses thus produced can cause the cracks they are supposed to explain. If, however, the ductility is locally altered by the treatment which produces these stresses, so that the material no longer remains homogeneous, it is evident that in the harder or less yielding portions there will be a concentration of the stress; and if any treatment could produce such a diminution of ductility as to render the plate brittle at a particular part, then these local stresses, if set up at that part, might easily produce a rupture.

The possibility of the change or alteration of the ductility of different portions of a plate is accordingly a most important consideration. It has usually been accepted that steel is practically homogeneous, and this is generally cited as being one of its most important qualities, and one in which it excels iron as a constructive material; and undoubtedly when the plates leave the hands of the makers, especially if they have been properly annealed, they possess this quality to a very high degree. But does this quality exist when the plates become part of a structure? Do none of the processes through which they pass, such as bending, hammering, punching, riveting, setting, &c., alter their ductility? If they do, and a plate gets into a structure with one part harder than another, then as the stresses upon each part of the plate, when it becomes strained, depend in a large degree upon the relations existing between the deformation and the stress accompanying that deformation, the hardest or least yielding portion will bear a greater stress than the softer portions, that is, the stress will not be equally distributed, and this localisation of the intensity of the stress takes place to the greatest extent in those parts which are hardest. Since rupture will commence when the local stress is equal to the ultimate strength, this unequal distribution of stress will reduce the strength of the structure below what it would have been if the stresses were uniform throughout. It is therefore extremely important that we should know whether any treatment to which steel plates can possibly be subjected during their being worked into the structure does alter their ductility, and the question as to the effect of working steel at a blue heat is one which requires thorough investigation, not only as to the kind of effect produced by such treatment, but also as to the amount of this effect. It might possibly be the case that a small amount of working at this temperature, such, for instance, as would occur in practice in closing a joint, may have so trifling an effect as to render it practically of no moment, while a larger amount of such working would be seriously objectionable. It should further be determined definitely whether the effects produced by such treatment are permanent, or whether subsequent annealing, or even local reheating to a red heat of the whole of the part affected, is sufficient to restore the ductility to its original amount. Another important point requiring solution is whether this property, which unquestionably is possessed by some mild steel, is inherent to all steel, or whether, as has been claimed by some steel makers, it is an accidental quality dependent upon some impurity in composition, or peculiarity in manufacture, and to which therefore other steels are not liable.

It is of course well known that hard steel, that is to say, steel containing a large proportion of carbon, is peculiarly sensitive to the variations of the rate of cooling down from a red heat, the quicker the rate of cooling the harder and more brittle it becomes, while the slower the rate the more ductile. It is this quality of "tempering" which makes such steel unfit for most structural purposes, and it is the comparative absence of this quality which has given mild steel such a commanding position as it now occupies as a constructive material. Yet even the mildest steel has its ductility and strength greatly modified by cooling. If made red-hot and suddenly quenched in cold water 26-ton steel has its strength increased to about 36 tons, and at the same time its ultimate elongation is considerably reduced. The field of inquiry as to the ductility of steel should therefore be held to include not only the effect of working at a blue heat, but also the effect of the greater or less amount of "tempering," which can easily occur in practice in working plates that have to be fired; and this not only with the very mildest qualities of steel, but also with steel of from 30 to 32 tons per square inch.

Attention is also being given to this question in America, and we publish this week a letter on the subject from Mr. F. W. Dean, member of the American Society of Mechanical Engineers. It contains a suggestion that a probable cause of failure might be a one-sided or non-axial stress upon the material. The effect of such a stress upon a homogeneous material would be somewhat similar to that of the fairer pull upon a material of varying ductility, such as we have been considering; in each case the result is that the stress is not uniformly distributed, with the consequence that the breaking stress is reached in one part before the full strength is developed in other parts, so that the plate breaks down piecemeal. Mr. Dean states that American engineers are often struck with the small part which the elastic limit of the material plays in discussions amongst English steel manufacturers and engineers. Undoubtedly we have got into a loose way of speaking of the ultimate strength and elongation of steel as being the most important qualities it possesses, and it has sometimes appeared that in discussions on the subject by our engineers the fact has been lost sight of that the elastic limit is a limit to the useful strength of the material, and also that it by no means follows that in advancing from mild to harder steel the useful strength is increased in the same proportion as the ultimate strength, since the elastic strength does not bear an invariable ratio to the ultimate.

The experiments quoted by Mr. Dean illustrate this point. Two sets of riveted joints were made of identical dimensions, the one being made from a steel having an ultimate strength of about 26 tons per square inch, and the other from steel of about 28 tons per square inch, the ultimate elongation in each case being about 32 per cent in a length of 10 in., but in the case of the soft steel the contraction of area was much greater than in the other, while the limit of elasticity not only bore a higher proportion to the ultimate strength, but was actually greater in the soft steel than in the other. The efficiencies of these joints, although they were identical in design, was in every case in favour of the softer steel, and their greater efficiency almost exactly counterbalanced the less original strength of the material, so that a structure of the 26-ton steel would have about the same strength as one of the 28-ton steel. Mr. Dean accounts for this by the softer steel being able to yield more when under great tension, and thus to allow the stress on the material to be more uniformly distributed, the yielding being continued longer in the case in which the elastic limit is higher than in the other.

The loose way of speaking of the ultimate strengths of materials as found by a testing machine, as though they were the actual strengths of the same materials when forming part of a structure, has no doubt arisen in part from the very common requirements of specifications as to these strengths; but it should not be overlooked that the tests which have become recognised as standards of excellence do not necessarily represent the strengths of the materials as actually applied in a structure. For instance, it is usual in specifications for cement to require samples made in a particular way to withstand certain tensile stresses, yet practically the cement in structures is never exposed to tension at all. So also with regard to steel plates, they are invariably specified to be able to withstand certain tension and elongation tests, even although they are to be used for furnaces in steam boilers, or for the compression members of a bridge, in which cases they will never be exposed to tension at all. Again, the so-called "temper test" to which steel is subjected is representative of a condition to which the material in all ordinary structures is never subjected, yet this is rightly looked upon as one of the most useful tests that can be applied to steel. The fact is, that steel, like other materials, is possessed of certain all-round qualities, and if some peculiarity in its composition or manufacture affects one of these qualities, it will in general affect the others as well; and as in framing specifications it is necessary to fix some points of excellence which are capable of easy and exact determination, the ultimate strength and elongation and capacity for withstanding bending being those properties which are most readily determined, are usually those which are specified with precision. It is in this way that the ultimate strength becomes generally spoken of as the strength of the material, and the elastic strength, or useful strength becomes lost sight of. The elastic limit, moreover, is not so easily and accurately determined as is the ultimate strength. Engineers are not even agreed as to what should really be considered as the elastic limit, but there is reason to believe that in the immediate future more importance will be bestowed upon this point, as there are now trustworthy autographic indicators applied to testing machines, which, if they do not definitely record the actual elastic limit, at least record quite clearly the breaking-down point, which is not far removed from that limit. As these instruments become more generally known, it is probable that they will come into more extended use, and we shall then have specifications fixing not only the ultimate strengths, but also the elastic strengths of the material. If such a practice ever becomes general, we shall still have to remember that the useful strength is not necessarily the elastic strength, as the useful strength must still depend upon the distribution of the stresses upon the section. The uniform distribution of such stresses is principally a question of workmanship, but even with the best workmanship, it is also dependent upon the proper choice of materials. Forms which are complicated and require much manipulation to obtain accurate fitting of the parts must be made of materials which will allow the finished work to be practically homogeneous, or else, as we have shown, we cannot insure uniformity of distribution of stresses. For such forms the mildest of steel will probably be the most suitable, while there are other structures for which steel of an intermediate strength will be an admirable material, if it possesses higher elastic strength.

While the responsibility of determining what kind of steel is the most suitable for any structure must rest primarily with the engineer, and not with the steel makers, it behoves both steel makers and engineers to investigate thoroughly the whole of the physical properties of steel generally, without a knowledge of which we cannot hope to attain to that perfection for which we all strive.

OVERRUNNING A PLATFORM AT KINGSWEAR.

In reporting upon a collision resulting from overrunning the platform on the 7th ult. at Kingswear station, on the Great Western Railway, Major Marindin says the train overran ninety yards, and that it was still running at a speed of six or seven miles an hour when the engine struck empty carriages against the buffer stops. The driver, fireman, and guard of the train state that the speed when approaching the station was no higher than usual, and the driver attributes the collision entirely to the slippery condition of the rails; but Major Marindin says he cannot think that any such reason is sufficient explanation for so serious an overrun The expression of opinion in a case of this kind is a serious matter, for against the sworn evidence of several men there is, after all, but this opinion, and a perusal of the evidence is in our opinion certainly in favour of the statements of the driver, stoker, guards, and station master. The train was a light one, consisting of only five vehicles, of which two were braked by the guards, and the engine, which was also braked on all wheels; and it is in evidence that the guards' brakes were on for about 380 yards, and the engine brake for about 500 yards, upon a level line and a sharp curve. It is argued that, "If the train, at the time the engine brake was applied, was running at only twelve miles an hour, as is stated by these witnesses, I cannot believe that any skidding would have rendered the brakes so useless as to leave a residual speed of six or seven miles an hour at the point of collision;" and Major Marindin therefore attributes the collision to a "miscalculation of speed by the driver, who should have been all the more careful when running into a terminal station in such weather, when he might have expected to find the rails slippery. It must, however, be stated in mitigation of his offence, that there can be no doubt that the engine wheels skidded upon reaching the points where the rails had been made more slippery by the application of salt to thaw the points. The driver had only been on duty an hour and a-half. If the driver had had a continuous brake to fall back upon, and had under these conditions been running at no higher speed, he would probably have been able to stop his train." Now it must be admitted that the accident was an unfortunate one; but it must also be said that the slipping from the points inward seems to have been actual though unusual. It is not at all improbable that the salting at the points was accompanied by oiling, and that taken with the statement that it was freezing at the time, the doubt is sufficient to enable one to hold the driver blameless.

LEAD IMPORTS AND EXPORTS.

There are some indications of change in the lead-mining industries of the North, though they seem to have begun in the pig lead branch, which is not that affording the best hope of endurance. The change is, in short, ascribable not so much to enlargement of the demand for lead as to restriction of the production, and especially of the imports. The extremely low price to which lead fell last year caused the closing of many mines, and caused the total production of lead to decrease. There were very considerable stocks of pig lead which had to be used, but these have been greatly reduced, and as the importation of lead has fallen off also, the comparative scarcity—even with a diminished consumption—has caused an increase in the value of lead. It may be remarked that the imports of lead have risen considerably of late years. In 1863 the imports into the Tyne were little over 12,000 tons, in 1873 they were over 20,000 tons, and at the end of another decade they had risen to over 28,000 tons. The lead thus brought in includes a large quantity of very rich lead, which is delivered on the Tyne, though the failure of the negotiations for the Spanish treaty, and the fact that lead can be more cheaply sent from that country to other European centres than it can to us, hinders the development of the industry with which the locality in the North indicated is very honourably associated. Still the imports have increased to the Tyne very considerably, whilst the exports have risen, though not in corresponding ratio. There remains still the want of a better demand for the manufactures of lead in various parts, and until this shows itself it is not very probable that there will be much enlargement of the exports. But when that comes the price will move with some rapidity, for it is seen that there is very great scarcity of pig lead, and the selling price is not yet high enough to cause the opening of mines that were closed because they were unproductive. Hence we may believe that the scarcity of pig lead will continue, with the consequence that the stocks will be low, and any enlargement of the exports of manufactured lead would speedily lead to the result we have indicated. It is by no means easy to say whence that demand will arise, but it is probable that the Continent of Europe will be more and more able to produce the lead it needs for its own use, and that we shall have to look to the East for the fuller demand which would give the stimulus that the lead trade has been so long in need of.

THE FALSE MARKING OF CUTLERY.

It is no new story that German goods are largely exported to foreign markets, where they are sold as Sheffield wares. They are mainly confined, so far as Sheffield is concerned, to the lower grades of cutlery, plated goods, and some descriptions of hardware. Immense mischief is done in this way to many respectable firms, and the Sheffield trade in general. The Cutlers' Company has laboured for years to prevent this fraudulent representation, aiming chiefly at the false marking of "Sheffield," or some word like Sheffield, or a name and trade mark which lead purchasers to believe they are buying Sheffield manufactures, when they are really obtaining wares which never touched English soil. The company has had a hard fight to convince successive Governments that it had a good case. For two years it had to struggle to convince one Government that it was its duty to ask foreign countries to make the wholesale frauds at Solingen and other places punishable offences. At length the Foreign-office came round to the view that the question was worthy of attention from the delegates at the International Conference. Now, the Cutlers' Company, after all its efforts, is likely to secure a practical means of meeting the evil at its source. In the meantime a cry has been raised by a Sheffield paper that vast quantities of German goods are bought by Sheffield manufacturers, branded with "Sheffield," or wrapped up in local labels so as to be re-sold as *bonâ fide* Sheffield productions. It is possible that this may be done to some extent by small, unscrupulous dealers, although no specific charge is bought against one of these; but that it should be carried on by any firms of repute in Sheffield, or to anything like the degree alleged, is utterly out of the question. If any purchaser, dumbfounded by the extraordinary fouling of their own nest by Sheffield people, should have any doubt as to the present trustworthiness of Sheffield ware, he may safely regard the stories of trade scandals as grossly exaggerated. There is a golden rule in buying cutlery as in other classes of merchandise. Following that rule, the British public will rarely be deceived. It is simply the honest old-fashioned principle, "Deal with a good house and pay a fair price."

"SLUDGE."

Those of our readers who are interested in the problem of the London sewage will doubtless have noticed, in our last week's number, a couple of letters on the subject, one from Mr. J. Bailey Denton, and the other from Lieut.-Colonel Jones. In these letters stress was laid upon the apparent fact that in estimating the cost of the plan which the Metropolitan Board are developing for a treatment of the sewage at the existing outfalls, we had omitted to include the expense attendant on the removal or disposal of the sludge. Had such an omission taken place, it would obviously have affected the validity of our calculations in a very marked degree. As the subject is one of considerable moment, and as it is most important that the public should be rightly informed concerning the facts of the case, we wish to make it known, in the clearest possible manner, that the cost of removing the sludge is completely included in the estimate which we gave. It happened that the word "sewage" was substituted for "sludge," in the following sentence in our article of the 5th instant, "It is calculated that this quantity," namely, 156,500,000 gallons of sewage per day, "can be sufficiently clarified at the outfalls, the sludge disposed of, and the effluent deprived of all odour during the summer months, at a total capital expenditure of a little under £1,000,000, and at an annual outlay of £100,000." We then went on to observe that interest on capital at 3 per cent. would be £30,000 per annum, making the total annual charge £130,000. In a matter of this kind, much will sometimes depend on a word, and our present explanation may serve to prove that, although we had apparently omitted an important consideration, we really had not done so. We desire to do every justice to the Canvey Island scheme, with which the plan of the Metropolitan Board was put in contrast, and our remarks were not influenced by any intention unduly to favour the latter.

THE COMMERCIAL PARLIAMENT.

It is satisfactory to find from the annual meeting of the Associated Chambers of Commerce, that the trade adversities through which the country is now passing have not had upon business men generally an effect unduly depressing. Adverse times have rather nerved them to fresh efforts, which cannot but eventually be crowned with success. To no better end could those efforts be directed than to the development of foreign trade, with which all-important subject the attention of the Chambers was upon this occasion almost exclusively occupied. Great importance is attached to the resolution from the London Chambers urging the extension of the Indo-Chinese Railway communication—a matter that likewise formed a subject of special resolution also from certain of the Northern trade centres. Of scarcely less gravity was the resolution moved by Mr. Alfred Hickman, M.P., on behalf of the Wolverhampton traders, and representing the views of the whole of the Midlands, in favour of the more rapid development of the Indian railway and canal system. The conference did well to adopt both these resolutions, and if the Government gave that prompt attention to them which their importance should secure, the industrial position of this country cannot fail to be bettered. In pursuance of the same end of foreign trade development, the resolution carried on behalf of Bradford, on the motion of Sir Jacob Behrens, on the subject of consular reports, is also worthy of early and attentive consideration from the Foreign-office. Let traders keep the foreign trade steadily before them in the resolute manner indicated in these proceedings, and they may find that all occasions for complaint will pass away.

THE BOARD OF TRADE AND RAILWAY RATES.

"The question has been under the consideration of the Board of Trade for three years," remarked the new President of the Board of Trade to the deputation from the Railway Rates Committee and the Conference of the Municipal Corporations of Lancashire and Cheshire, which interviewed the right hon. gentleman on the day of our last publication. As the result of that consideration we are now to have another measure upon the railway rates question laid before the Commons by the Ministers of the Crown. In a few days manufacturers and other traders will be acquainted with its merits. It will be hoped that the Bill will be of such a character as will gain for it more cordial support from manufacturers than was accorded to the Bill which was introduced by Mr. Chamberlain. Probably manufacturers will be liable to some disappointment if they are expecting a measure of as full and sweeping a character as that which the Railway Rates Committee, under the leadership of Lord Henniker, are themselves prepared to lay upon the table of the House, backed by the names of Mr. Barclay, M.P., and Mr. Hunter, M.P. But it would be unwise to forget that half a loaf in this matter would be better than no bread. And the Board of Trade conceives, rightly or wrongly, that the interests of the traders and of the railway companies are, after all, very much identical, and they cannot forget that the sum invested in the railways of this country amounts to probably some £70,000,000 or £80,000,000. Manufacturers, in considering Mr. Mundella's Bill, must not overlook the fact of the powerful interests by which the carriers are represented in Parliament.

LITERATURE.

Malt and Malting: an Historical, Scientific, and Practical Treatise, showing, as clearly as existing knowledge permits, what Malt is and how to make it. With full descriptions of all Buildings and Appliances, together with detailed Definitions of every matter connected therewith. By H. Stopes, F.G.S. London: F. W. Lyon, *Brewer's Journal* Office. 1885. 662 pp.

In a new book on this subject there is necessarily much to be said; for while the old and the new methods are still struggling for supremacy, chemistry and vegetable physiology have in this, as in many other arts, gone hand-in-hand in revolutionising the older ideas as to the conversion of barley into malt, and the use of malt in brewing beer. To a very large extent Mr. Stopes's book cultivates a field which has been little worked, for although a valuable feature in his book is a bibliography of the subject extending over 159 pages, supplemented by a list of English patents occupying forty pages, there is, we believe, no modern systematic work in the English language on malting as understood at the present time. He has been able to appeal to a vast literature; but the labour of separating that which is useful from that which is but history must have been proportionate to the number of references made and the difficulty of determining what may really be considered absolute, and what hypothetical in the new.

He divides his subject into five parts, namely historic; the materials and their properties; building and tools; processes of manufacture; literature and statistics.

We may pass over the historical part of the work as one which is of great interest, but not perhaps one for which the book will be bought by practical men. The subject of the second part is comprised under the heads of air, fuels, antiseptics and water, and the commencing remarks refer to malting as being a decaying industry in Great Britain. Is is a remarkable and curious fact, but it does not appear due to anything so much as to change in public taste, although the employment of sugar is perhaps enough to make the quantity of malt required stationary. Science has done something by showing how by proper mashing an increased extract may be obtained, but the change in the character of the beers and ales now generally consumed, low gravity ales being the rule, has done most, by making possible the use of materials that could not be used formerly. Brewing has progressed in England, but it is much questioned whether malting has done so, many brewers maintaining that the quality of malt obtainable in England now is inferior to that of years ago, when old methods and old appliances were in vogue. It is noteworthy, also, that in these years of agricultural depression, when one would have thought English farmers would have been on their mettle to keep out foreign grain where possible, foreign barley has not only acquired a good market in England for malting because of lower price, but much of it fetches a higher price than even the eastern counties' barley; and it would seem that the cultivation of high-class barleys for malting, which used to be one of the best paying crops, is an art lost by the English farmer. The purchase of foreign barley at the higher price is an indisputable fact. Whether malt is really inferior to-day to that of a quarter of a century ago may be open to question; and it is a question difficult or impossible of solution, for a brewer is likely to condemn modern malt as inferior to the old without remembering the great difference between the desired products in the old, heavy, strongly alcoholic beers, with many imperfections covered by plenty of malt extract and body, as compared with the slightly alcoholic, very light or low gravity beers in vogue now, and in which imperfections are so easily observable; and not only this, but that the very light ales are much more difficult to produce by the English infusion system, especially for early use or for bottling, as compared with the German and Austrian cooking systems as described in the series of articles published by us some years ago.*

The influence of air on germination and the quantity of air at different temperatures and hygrometric states are first treated, and Mr. Stopes so far seems to be ready to make his book what it pretends to be, though it is instructing in his own business. Here it may be remarked that the table of expansion of dry air is correct, but the method of calculation given when dealing with the construction of buildings is not quite right. The expansion of air is calculated by means of its coefficient ·0020284 instead of the formulæ $V^1 = V \times \frac{460 + t^1}{460 + t}$. The difference in the result with the range of temperature concerned, is small, but it is enough to make 157 volumes appear 160 volumes. The author quotes Mr. Le Vau, where Le Van is meant. In dealing with fuel, the author has a long subject in hand, although the calorimetry of fuel is but a secondary matter, for the constituents of fuel the products of combustion of which affect the product in hand, are of the first importance. Antiseptics naturally follow fuel, inasmuch as some fuels provide these, as far as the last stage is concerned; but the proper use of antiseptics in the earlier stages is here chiefly considered. The character of the water most suitable next occupies attention, and the effect of different constituents treated, the author apparently agreeing with general opinion concerning the superiority of hard water for brewing purposes. For steeping water he mentions the use of salt, but does not say what proportion, and his index is here at fault. On the effect of light upon germination, the author differs from M. Daubeny and M. Planchon, and, as a result of his own experiments, concludes that germinating is most rapid and efficient in the dark or behind dark glass, such as dark blue. The minor malt-producing grains receive some attention, but barley, the chief of malting grains, is treated with great minuteness and care by the author in all its phases—from the cultivation, through the machines, mills, chemical and botanical laboratories, to the malt-kiln and brewery. The author treats of the influence on barley of different manures from a grower's point of view, none of them seeming to have injuriously affected the grain for malting. It is, however, here noteworthy that calcium sulphide, such as may occasionally result from use of town ashes and refuse on land, has been shown to act in this way.

Malt itself receives special attention; and maltings, more especially the kilns, are described and illustrated by typical engravings. The Galland and Saladin systems of "pneumatic malting," as it is called,† that is to say, maltings in which artificial supplies of air are employed to remove the saturated air in the malting, are described at length, and Mr. Stopes has adopted the system in conjunction with his double-floor kilns. He then deals with the sizes and costs of maltings, and at much length, with illustrated accounts of malting, malt kilns, and malt store machinery. There is no doubt that much larger quantities of malt can be turned out of a given malting now at a lower cost, as compared with a few years ago, but whether there is any improvement in the quality of the malt, although numerous extra precautions in washing barley, washing it in steep, washing store floors, using antiseptics, and especially pure fuel, it is not easy to say. Mr. Stopes has not given as many or as complete drawings of maltings as might be considered desirable, although as we have said, typical drawings of kilns are given. For drawings of continental maltings and breweries we may with confidence refer to the articles above alluded to.

We cannot follow the author through his chapters on drying, finishing, and storing; but we may say that his book is one which no one interested in the manufacture of malt can afford to be without. His index is a long one, but it is not complete, although, it occupies thirty-one pages. Hundreds of things are mentioned in the book that cannot be found by the index. Much of this defect is owing to the way in which a lot of things of one subject are grouped under one head. For instance, we find "Brewing Processes" followed simply by about 150 page references, and a reader would have to look, perhaps, through half these to find the process he wants. This obtains with most other subjects, and it is a pity that a book which is the result of so much labour should be defective in the very important part, the index.

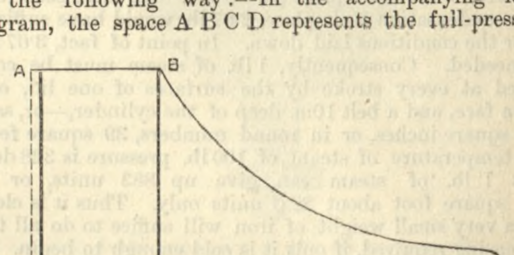
* The Engineer, vol. xlix., 1880, p. 435; vol. l., 1880, pp. 207, 269, 302, 345, 407, 413.

† See The Engineer, vol. lvii., 1884, pp. 76, 470, and 482.

CONDENSATION IN STEAM CYLINDERS.

It is possible that no subject connected with the steam engine has received more attention than the condensation which takes place in the cylinder. The question is as old as the days of Watt. He invented the separate condenser to mitigate it, and he added the steam jacket to reduce it still further. D. K. Clark, Isherwood, and many other engineers have written largely concerning it. Its theory is complete, and yet, strange to say, all the information possessed on the subject is strictly indirect, and no one knows at this moment precisely what takes place in a cylinder, nor will they know until experiments of an entirely novel character are undertaken and carried out by some competent authority. This ignorance makes itself manifest in many ways. The widest diversity of opinion, for example, exists concerning the utility of steam jackets, about which there ought to be no uncertainty whatever if the accepted theory of condensation is really true; and extraordinary statements are made by men of no mean authority, which it is almost impossible to prove or disprove. Discussions are carried on by engineering societies which extend to great length and are entirely barren of results. It is time, we think, that steps were taken to settle, once and for all, what is and what is not true about condensation. As an example of confusion of opinions we may cite the discussion which followed on the reading of a very good paper "On the Present State of the Theory of the Steam Engine," read by Mr. Henry Dyer, C.E., M.A., before the Institution of Engineers and Shipbuilders in Scotland. In the course of this discussion Mr. Turnbull spoke in very high terms of steam jacketting. Among other things he said, "Sea-going engineers would tell us that even in unjacketted high-pressure cylinders, after they had warmed to their work, there was no accumulation of water requiring the use of drain cocks." If this were true in the full sense jackets would not be required. A very large quantity of water will find its way through an engine without making its presence evident by being slapped against the cylinder covers. If any engine ought to be free from condensation in the high-pressure cylinder, the triple-expansion engine would be that one. But our own experience coincides with those of many other engineers; and we can positively state that the high-pressure cylinder is always drowned with water, with the best boilers, and this with the jackets in full work. We tested a triple-expansion engine for this very thing last summer, and found that whether the jackets were full of hot water or carefully blown down, there was no perceptible difference; and it was impossible to get a diagram free from the influence of water in the cylinder, and the indicator cock always blew wet steam. The low-pressure cylinder, on the contrary, never betrayed the presence of a spot of water, and it was unjacketted. We propose here to consider the phenomena as they seem to exist, and to direct attention to the line which experiments should take.

The theory that steam condenses in the cylinder of an engine is based on very simple facts. (1) The presence of water is recognised by sight when an indicator cock is opened, and by the continued dropping of water from high-pressure glands. (2) It is proved by direct experiment in the following way:—In the accompanying ideal diagram, the space A B C D represents the full-pressure

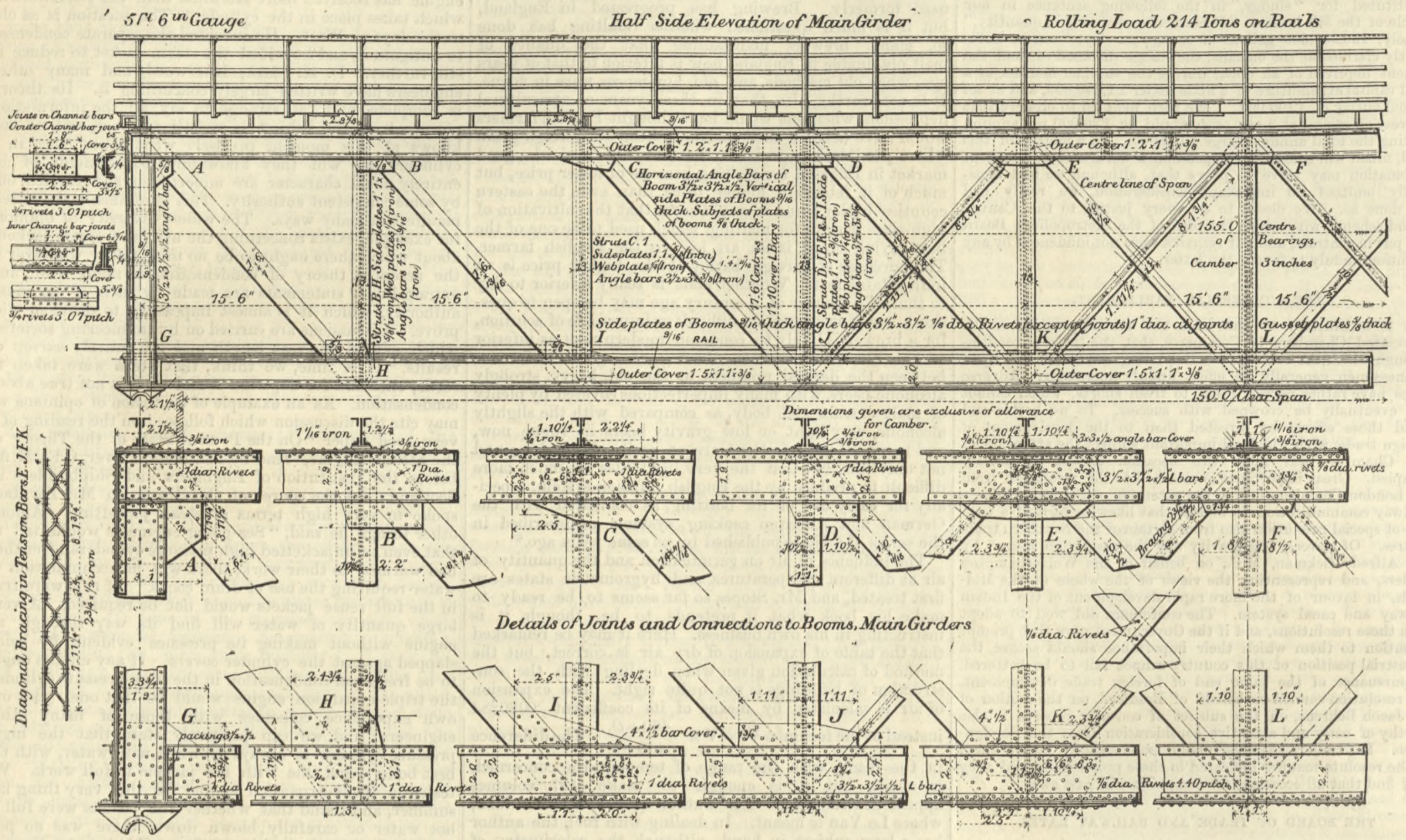


part of the stroke. The dotted line shows the clearance space. Now, given the size of the cylinder, the point of cut off B, and the pressure of the steam, we can tell the weight of steam required to fill the space. Let us take, for example, a cylinder, with 2000 square inches of piston area. It will be nearly 50½in. diameter. Let the steam be cut off sharp by Corliss gear when the piston has made 9½in. stroke. Allowing ½in. for clearance space, we find that when the steam is cut off, the space A B C D and that included between the dotted and full line equals $10 \times 2000 = 20{,}000$ cubic inches $= 11·574$ cubic feet. Let the pressure be 100 lb. absolute. One cubic foot will weigh ·2307 lb. and $11·574 \times ·2307 = 2·67$ lb. This is the weight of steam per stroke accounted for by the indicator, and we have only to multiply this by the number of strokes per hour, and divide by the indicated horse-power, to get the weight of steam used per horse-power per hour. If now we also weigh the quantity of water pumped into the boiler per hour, and divide by the indicated horse-power we shall have, if we make a deduction of about 5 per cent. for insensible priming with a good boiler, and 10 per cent. with a bad one, the weight of steam supplied per horse-power per hour by the boiler. In all cases the latter figure exceeds the former. Thus the indicator showing, say, 13 lb. per horse per hour, the weight of water pumped into the boiler may be 20 lb. to 25 lb. We have seen that the indicator accounts for 2·67 lb. per stroke. The actual quantity of steam supplied by the boiler may be 3·67 lb.* What becomes of the difference? The answer is simply that it is mainly condensed by coming into contact with the cold cylinder, a small proportion being liquefied by the performance of work. This quantity is, however, so insignificant that it may be neglected.

It is very necessary that the bearings of this assumption should be fully comprehended; very often they are not. The usual mistake is to mix up all the cylinder condensing surfaces together—to regard, in a word, the whole cylinder as playing the part of condenser. A little reflection will

* It must be understood that the 3·67 does not represent what will of necessity occur; the difference between the steam accounted for by the indicator, and actually supplied, is a very uncertain quantity, varying not only with different engines but with the same engine under different conditions of load, speed, and expansion.

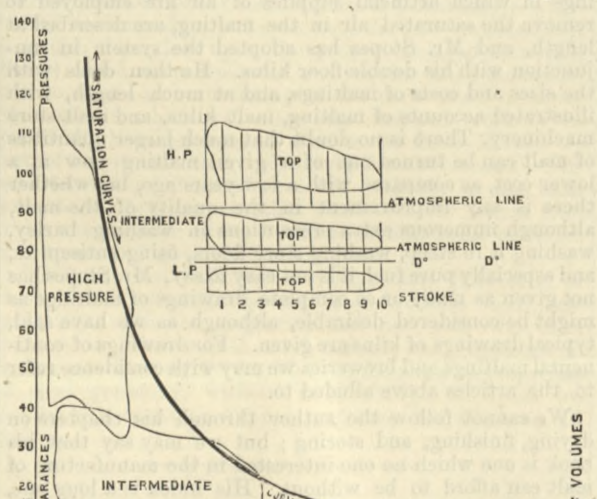
LATTICE BRIDGE OVER THE SUTLEJ.



suffice to show that this is quite wrong. The boiler can only supply steam while the admission port is open. The moment the cut-off valve closes the cylinder is isolated from the boiler, and the steam does its work during expansion just as though the boiler never existed. During this, the expansion part of the stroke, condensation may or may not take place. Whether it does or not, however, will not affect the weight of steam supplied to the engine, though it will affect the power developed, and therefore the weight of water used per horse-power. To prevent confusion we prefer to say nothing about horse-power, and deal only with what takes place per stroke. We have seen that if no condensation took place, 2·67 lb. would have sufficed under the conditions laid down. In point of fact, 3·67 lb. are needed. Consequently, 1 lb. of steam must be condensed at every stroke by the surfaces of one lid, one piston face, and a belt 10in. deep of the cylinder,—or, say, 5590 square inches, or in round numbers, 39 square feet. The temperature of steam of 100 lb. pressure is 328 deg. Thus 1 lb. of steam can give up 883 units, or to each square foot about 22·6 units only. Thus it is clear that a very small weight of iron will suffice to do all the condensing required, if only it is cold enough to begin. If its temperature has fallen to, say, 200 deg., then, the specific heat of iron being about one-ninth that of water, each 9 lb. of iron would require 128 units to restore it to 328 deg., the temperature of the incoming steam. As there are only 883 units available, $\frac{883}{128} \times 9 = 62$ lb. = the weight of iron to be heated at each stroke. From which it appears that the temperature of the metal need not be affected to a greater depth than about one twenty-fifth of an inch to account for the condensation which takes place.

This is all plain sailing, and the figures and facts we have given are those commonly used to explain what goes on inside a cylinder. It is hard to dispute the accuracy of such reasoning, as regards single cylinder engines at all events; but the moment we come to apply this line of argument to compound or triple-expansion engines with jackets, we are beset with difficulties. In the first place, the range of temperature will not be, in the high-pressure cylinder, more than about 47 deg., instead of 128 deg. But furthermore, the steam in the jacket being at least as hot as that going into the cylinder, the cylinder walls should be maintained at so high a temperature that condensation in the cylinder is impossible. The piston face is not jacketted, but the lid of the cylinder usually, if not always, is. Under the circumstances it is very difficult to explain why condensation takes place, and it is usually stated that none, or next to none, does occur; but facts entirely refute this, as much as 30 and 40 per cent. of the steam being reduced to water,—as much, indeed, being condensed as though the engine had but one cylinder; and so doubtful is the advantage of jacketting, that engineers neither know what cylinder to jacket or whether it is worth while to jacket all or none. It is vain to dispute the accuracy of the statement that condensation takes place, as far as the space A B C D is concerned, to just the same extent in the high-pressure jacketted cylinder of a triple-expansion engine as it does in a simple engine, and to get out of the difficulty it is now argued by many eminent authorities that the indicator is in fault, and that its statements are untrustworthy. From what we have said it will be clear that the only practical means we have of estimating the amount of condensation which takes place in a cylinder is the indicator. There is a theoretical means of arriving at the same end, based on the well-known $\frac{T-t}{T}$ theorem, by the aid of which we can calculate what weight of steam is required to give a horse-power per hour under limiting conditions stated for any particular engine. The results obtained in this way go, however, to show that condensation very often takes place to even a greater extent than the indicator denotes.

But there are further puzzles to be solved. How is it, for example, that the low-pressure unjacketted cylinder, open at each stroke to the frigorific influence of the condenser, does not condense steam, but, on the contrary, re-evaporates the water carried into it from the intermediate cylinder? It is well known that while some 30 per cent. of all the steam made by the boiler may be condensed in the high-pressure cylinder, before the cut-off valve closes, well nigh the whole of this will be re-evaporated in the intermediate, and especially the low-pressure cylinder. It may be taken as proved that a cylinder cannot evaporate more steam than it condenses, because all the heat available for re-evaporation during one stroke must have been imparted to the metal by steam during the preceding stroke or part of a stroke. Yet we find the low-pressure cylinder actually acting like a boiler, taking in wet steam continually, and sending it away dry, or at least dryer than it was when it got it, the expansion curve often rising above the curve normal to the pressure and rate of expansion; and curiously enough, if the conditions are such, as they sometimes are, that the low-pressure cylinder does not work dry, then it will be found that the line rises above the theoretical curve in the high or high and intermediate cylinders. A good example of this is supplied



by the accompanying diagram, calculated by Principal Jamieson, and published in connection with Mr. Dyer's paper referred to above.

We have said that further direct experiment is wanted to settle such problems as those we have cited. The thing to be ascertained is the actual rise and fall of temperature in the surface of the metal of a cylinder, and we believe that this can be done by inserting a thermopile properly designed in the cover of a cylinder, and causing it to actuate a pencil moving on a drum, on which the curve of temperature would be traced. No doubt the problem how to ascertain the temperature is attended with difficulties, but we cannot see that they are insuperable; and those gentlemen who have experimental steam engines, as for example Professor Unwin, Professor Kennedy, and Professor Smith, of Mason College, would no doubt easily devise means of carrying out to a satisfactory conclusion an experiment of the utmost importance—so important indeed, that until it has been made the theory of the steam engine cannot possibly be regarded as complete at all points.

It may be asked how it happens that the triple expansion engine is so economical if condensation takes place in it to so large an extent. We have already given the answer to this question more than once. Almost all the water resulting from condensation in the high-pressure cylinder is re-evaporated in the others, and the resulting steam being worked expansively, great economy ensues.

BRIDGE OVER THE RIVER SUTLEJ.

WE illustrate above and on page 168 a somewhat remarkable bridge, for the construction of which the Indian Government recently received tenders. It will be seen that footways are constructed on the top booms of the main girders. There are twenty-seven spans of 150ft. each.

Materials.—The main girders are to be of steel, with the exception of the intermediate vertical struts, the diagonal bracing for the central tension bars, the diaphragms of the top booms, and those of the end vertical struts, which parts are all to be of wrought iron. The cross and longitudinal girders of the lower roadways and the corrugated floor plates of the upper roadway are to be of steel. The cross and longitudinal girders of the upper roadway, the hand-rails, the channel bars of the footways, and the flooring plates, transverse angle bars, and longitudinal T bars of the lower roadway are to be of wrought iron. The whole of the rivets used throughout the work are to be of steel. The steel and wrought iron must be of such strength and quality as to be equal to the following tensional strains, and to indicate the following percentages of elongation and of contraction of the tested area at the point of fracture:—

	A. Tons.	B.	C.
Steel plates, either with or across the grain, angle, or flat bars, not less than	27	20	20
Or more than	31		
Wrought iron, round and square bars, and flat bars under 6in. wide	24	20	..
Ditto angle, T, and channel bars and flat bars 6in. wide and upwards	22	15	—
Ditto plates	21	10	—
Ditto plates across grain	18	5	—

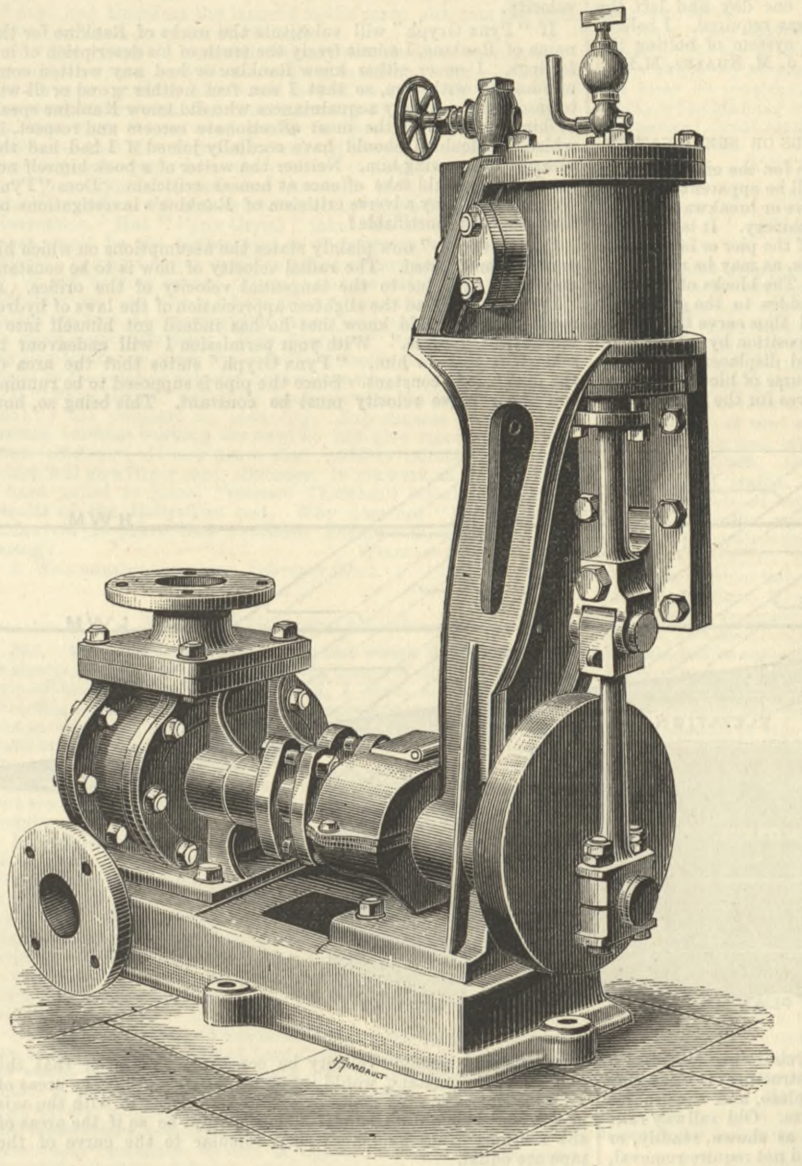
A, tensional strains per square inch; B, percentage of contraction; C, percentage of elongation in 8in.

Strips of steel, whether cut lengthwise or crosswise of the plate, bar, or angle bar, heated to a low cherry red, and cooled in water at a temperature of 82 deg. Fah., must stand bending double round a curve of which the diameter is not more than three times the thickness of the piece tested. In addition to this, angle and flat bars must stand the test known at Lloyd's as the ram's horn tests. Tests for tensile strength are to be made from side and end shearings from every plate, and from at least one angle or flat bar from every charge of steel. To guard against the occasional acceptance of brittle or dangerous steel, the manufacturer is to preserve a side and an end shearing from every plate, and an end shearing from every flat bar and angle bar, in order that it may be tested by bending cold in the presence of the Inspector-General or his deputy. Our engravings are so complete that further description is unnecessary.

EXTENSIVE floods have occurred at Ballarat, Victoria, owing to the continuous rain. All the low-lying portions of Ballarat East were flooded, and on the main road traffic was entirely suspended. The water was from 4ft. to 5ft. deep. A Melbourne paper says the Bond-street Bridge was swept away, and the Grenville-street Bridge, near Alfred Hall, was likely to follow suit.

ENGINE AND ROOT'S PUMP.

MR. A. MUMFORD, COLCHESTER, ENGINEER.

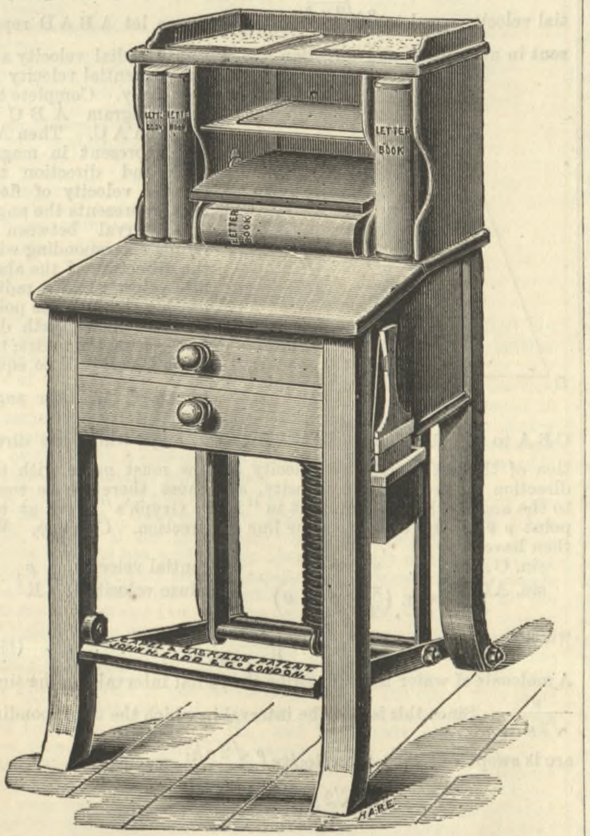


COMBINED ENGINE AND ROOT'S PUMP.

IN our impression of the 12th inst. we illustrated the new forms and method of construction of Root's blowers and pump, and referred to the design of a combined engine and pump now being brought out by Mr. Okes, of Queen Victoria-street. This we now illustrate by the accompanying engraving, which needs no further description than that published in the impression already mentioned.

CAPEL AND GASKILL'S COPYING PRESS.

THE copying press here illustrated is made by Messrs. J. H. Ladd and Co., of 11, Queen Victoria-street, E.C., and for office work has certainly much to recommend it instead of the old screw press.



It will be seen that the platen is worked by a treadle lever. It is simple, quick in action, takes little room for working, and the arrangement of the table, drawers, book places, waterproofs and letters, is a very convenient one. The direct vertical movement of the platen assists this by putting the whole stress on the two vertical bars, and thus removing the ordinary press frame and revolving screw handle.

STREET CLEANING IN VIENNA.

IT would be very rash to assert that the public streets of Vienna, as a rule, can compare with those of London, Paris, or Berlin, either as to cleanliness, freedom from stench, or quality of pavement; but, in emergencies like the recent fall of snow, as far as the city or inner town is concerned, the rapidity with which the impediment was removed offers an example which might profitably be followed in other large towns.

The cause, however, of the speedy removal of this obstruction does not lie in any extraordinary display of energy on the part of the authorities, so much as in their foresight in inserting conditions in their contracts with the Transport Company, as public scavengers of the city proper, and with the tramway company, using the Ringstrasse. The former has not only to keep the streets swept and watered at ordinary times, but, in cases of falls of snow, is compelled to remove the same as speedily as possible; first of all from the carriage way, or from so much of it as does not belong to the tramway, and afterwards from the streets altogether. Of course there is a certain amount of uncertainty in submitting a tender under such conditions, more especially as this is a case in which no amount of personal influence can be brought to bear on the officials of the Weather Office to induce them to disclose the secrets of their department. And it is difficult to see exactly on what basis the calculation is made, unless those entrusted with the problem have some means of substituting an approximate value for what, to the uninitiated, seems but an element of chance. Nevertheless, taking it all round year for year, the company has not done badly; the last few winters have been exceptionally free from snow, and if the amount of work thrown on it this season has been excessive, it has only helped to strike an average, and reduce the profits of previous winters more nearly to the standard on which it must have based its expectations.

Outside the city proper in the other nine Bezirks or districts within, and in the suburbs without, the octroi lines, very little, comparatively speaking, is done to clear the roads, excepting in the main streets through which the tramways run, and in which they have the same obligations as in the Ringstrasse. Most of the side streets still present a wretched appearance, as the vestries, under whose control they stand, have not the means, even if the traffic required it, to enter into such comprehensive arrangements as the City Corporation.

The pavements throughout the whole of Vienna are under the special care of the Haüsbesorgers, or porters, who are bound to keep the same free from snow and to strew them with sand, sawdust, or ashes when slippery. Neglect of the former duty renders them liable to a penalty; and, of the latter, subjects them to the chance of damages to be paid to any one falling within their boundary. It is an ill wind that blows good to no one, and the exceptionally heavy fall of snow in January, came as a blessing to the unemployed. It is said that as many as 26,000 men found work in the first days; but whether this be so or not, large numbers who had besieged the town hall for employment, or relief, were distributed amongst the several districts with advantage to themselves and to the public comfort and quiet. The following data as to the work executed by the Transport Company in the inner town will give some idea of what a fall of snow such as the last means in Vienna. The area of the streets and open places of the city, exclusive of public gardens, is 9,257,000 square feet, the mean depth of snow was over 21¾in. This, supposing the same to be solid, represents 16,779,470 cubic feet; but as the partial thaw, which set in almost immediately after the fall, helped to consolidate the mass, the actual quantity removed, calculated from the wagons and carts employed, amounted only to 6,711,788 cubic feet.

In the removal of this were employed:—

55,414 day labourers at 1s. 6d.	£4,156	1	0
95,408 two-horse wagons, holding about 60 to 70 cubic feet, including horses, tipping, &c., per load at 1s. 3d...	5,963	0	0
583 one-horse carts for narrow streets, 20 four-horse snow ploughs, 5 mechanical sweepers ..	475	0	0
Total	£10,594	1	0

The speedy removal of such an obstruction, especially when it necessitates no extra strain on the ratepayers, is a great boon to the traffic; but the method of getting rid of it, from a sanitary point of view, is open to numerous objections.

The only waste ground available for so large a deposit is the slopes of the river Wien; and as the majority of the sewers of the city, and at least three of the larger districts, empty themselves into this savoury stream at varying levels above its bed, their mouths are hermetically closed for weeks to come, until such time as the sun has gained sufficient power to liquefy the accumulated mass. The anticipation of this gradual process of liquefaction which must precede the liberation of the sewage, and of the fermentation in the sewers, which meanwhile has no other outlet than the gratings in the streets, is, perhaps, although less patent, more obnoxious than untidy streets and dirty snow, with the certainty that when it melts it will help to remove the impurities which its artificial removal only tends to increase.

TENDERS.

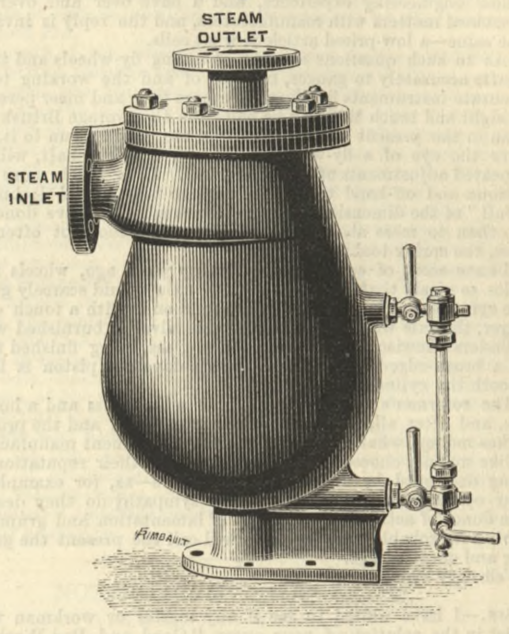
FOR new iron foundry for Messrs. W. N. Allen and Co., York-street Works, Lambeth. Mr. F. W. Hunt, architect, 27, Upper Baker-street.

	£	s.	d.
Mr. Haylock	789	0	0
Messrs. Bywater	786	0	0
Mr. Johnson	750	0	0
Mr. Downs—accepted	696	0	0
For new offices in Addington-street.			
Messrs. Lathy Brothers	1860	0	0
Messrs. Bywater	1850	0	0
Mr. Downs	1792	0	0
Mr. Johnson—accepted	1645	0	0
For new fitting shop in York-street.			
Messrs Lathy Brothers	540	0	0
Messrs. Bywater	450	0	0
Mr. Downs	441	0	0
Mr. Johnson	415	0	0

BOYS AND CUNYNGHAME'S PATENT STEAM SEPARATOR.

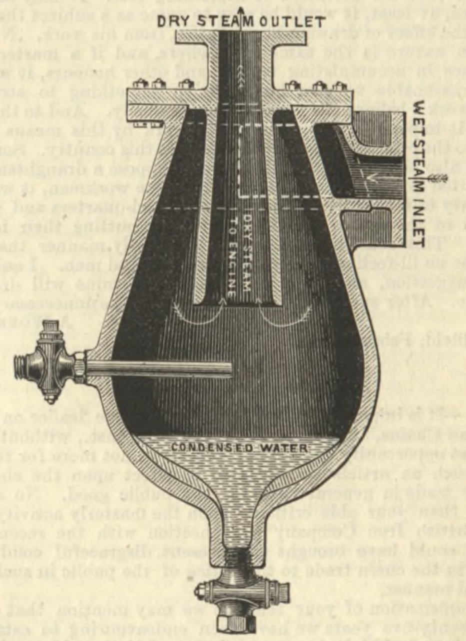
ONE of the most simple and at the same time efficient modes of separating water from steam previous to its passage to a steam engine is represented by the subjoined woodcuts. Fig. 1 represents the external appearance, and Figs. 2 and 3 sectional views, Fig. 2 being a vertical section through the inlet pipe, and Fig. 3 a horizontal one at the same place. By reference it will be

Fig. 1



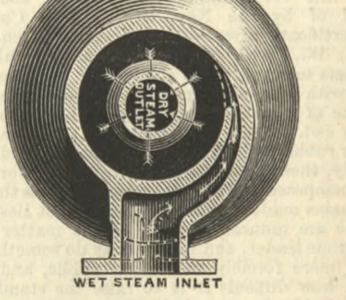
seen that the steam, by passing through the curved pipe tangential to the circumference of the chamber, acquires a rotating or spinning motion, which speedily separates the heavy from the light particles, the water flying off to the circumference

Fig. 2



and the dry steam remaining at the centre, from whence it is drawn off to the steam engine for use. We lately had an opportunity of being personally present at a trial of one of these machines. The steam boiler supplying a steam hammer was

Fig. 3



filled up in order to make it prime, which it did to its heart's content until some 5in. were drawn off, but not a drop reached the hammer, the whole being intercepted by the separator. Messrs. James Simpson and Co., of Grosvenor-road, have had one of these machines at work at the Lambeth waterworks' pumping station at Brixton for some time, and in a letter to Mr. J. C. R. Okes, of Queen Victoria-street, in whose hands this patent is placed, speak of it in the highest terms as a "thoroughly successful instrument based on scientific principles." The patentees are Messrs. Boys and Cunynghame.

LETTERS TO THE EDITOR.

(*Continued from page* 167.)

GOOD AND BAD WORK.

SIR,—I have read attentively your recent article on the above topic, and while agreeing with a portion of it, I desire to comment on more of it. Your argument, as I understand it, is that as there is no more profit on bad than on good work, there is not even that excuse for damaging our credit in foreign markets by exporting rubbish. On this I must join issue with you. I am a profound believer in cause and effect. All depends upon either of two points, viz., the meeting of an existing demand or creating a new one. The first is the easiest, and is attended with the quickest results; whether it is the most successful in the long run is quite another matter. *Carpe diem* is the maxim now-a-days. Besides, why need any man trouble himself, and spend a lot of his capital and his time making a good reputation for himself? Others, through, I might say, generations, and at infinite cost and unceasing labour, and the most scrupulous honesty and honour, made world-wide reputations for their trade name; and cannot Tom, Dick, Harry, Messrs. Swindlem, Cheatem and Co., *et hoc genus omne*, use their trademarks and forge their brands with impunity?

Apart from this, however, what is to be gained by making the general run of export machinery, or for that matter, the home article, any better than it is? The user wants what is cheap; as long as it does some work, and looks to have lots of metal in it, that is all that nine out of ten purchasers want. I have many years' engineering experience, and I have over and over again discussed matters with manufacturers, and the reply is invariably the same—a low-priced article is what sells.

As to such questions as that of boring fly-wheels and turning shafts accurately to gauges, the use of and the working to such accurate instruments involves both more time and nicer perception of sight and touch than can be had from the average British workman in the present day. Piecework, too, won't "run to it." To bore the eye of a fly-wheel to fit, say, a 3½in. shaft, will need repeated adjustments of the boring tool. It is much more expeditious and off-hand to set the tool to take a good slashing cut "full" of the dimension, and run it through and have done with it, than to mess about with gauges and a tool not often used now, the spring tool.

I have seen, of course a great many years ago, wheels fitting axles so nicely that when greasy the axle would scarcely go into the eye, and yet which would run round on it with a touch of the finger, the axle when wiped shining like silver so burnished was it; cylinders likewise bored out smooth as glass, being finished finally by a broad-edged spring tool. Now-a-days the piston is left to smooth the cylinder.

The reformer's task is usually both a thankless and a hopeless one, and after all, if the consumer is satisfied and the producer makes money, what more need be said? If eminent manufacturers in like manner choose to stand passive while their reputations are being destroyed by unprincipled swindlers—as, for example, see your correspondence columns—what sympathy do they deserve? One ounce of action is worth a ton of lamentation and grumbling. I think it probable that posterity will call the present the grumbling and cheating age. H.

February 22nd.

SIR,—I have waited to see if any master or workman would assist in the solution of your query "Good and Bad Workmanship," and, considering the importance of the question, it is surprising that it has not received more attention. Technical education will do doubt supply a long felt want. But I maintain there is not sufficient encouragement given to the artisan. Some people will say he may become a foreman and possibly an employer; but as the years go by and he finds the chance of rising as far off as ever, he will turn his attention to something else. It may be music. Politics, at least, it would be easy to name as a subject that would have the effect of drawing his attention from his work. Now, Sir, human nature is the same everywhere, and if a master finds a pleasure in accumulating medals and other honours, it would be only reasonable to give his workmen something to strive for. Piecework I believe the most practical remedy. And to those who think it impossible to turn out good work by this means I would refer to the principal locomotive makers in this country. Something might also be done in this direction. Suppose a draughtsman was appointed to receive suggestions from the workmen, it would be his duty to forward the good points to head-quarters and give his advice to those who found a difficulty in putting their ideas on paper. This could be done in such a friendly manner that there need be no ill-feeling between the foreman and men. I only make this suggestion, and hope abler pens than mine will draw up a scheme. After such a letter as this it would be unnecessary to say I am A WORKMAN.

Sheffield, February 23rd.

GOOD AND BAD CHAINS.

SIR,—It is impossible to read your admirable leader on "Good and Bad Chains," in your issue of the 19th inst., without siezing the first opportunity of thanking you for it, not more for the great good such an article is calculated to effect upon the chain and anchor trade in general than for the public good. No stronger power than your able criticism upon the masterly activity of the New British Iron Company in connection with the recent chain frauds could have brought the present disgraceful condition of affairs in the chain trade to the notice of the public in such a substantial manner.

In confirmation of your remarks we may mention that for the last twenty-five years we have been endeavouring to establish a special brand of high-class crane chain and chain cables, which has been duly registered and is well known in the trade as "A1 Special Best Best J. W. and Co." This chain is made from iron of a specially high quality, prepared for this company only. Nevertheless, we are constantly confronted with and annoyed by persons endeavouring in some way or other to pirate this brand as a whole or in part, and pass off inferior chains for it. Some time ago, and at great trouble and expense, we obtained an injunction against a late firm in Tipton to restrain them from infringing this very brand; and now in the case so justly complained of by the New British Iron Company we find the test certificate given with the chain is endorsed with the letters "J. W.," which is to some extent calculated to lead our customers to suppose the chain may have been in some way connected with our own specially branded chains, the present selling price of which is 23s. 6d. per cwt. for ½in. short link, and 18s. 6d. per cwt. for 2in. chain cables, as against about 11s. and 9s. per cwt. for rubbish of the same size, and intended to represent the same quality, though, of course, the price paid for both the iron of which it is composed and the workmanship is less than half that paid by us for chains made of our "A1 Special Best Best J. W. and Co." brand. We are induced to refer to the matter of prices by the remark in your leader, and hope it may do something to bring this crying evil more forcibly before the public, and that they may understand how difficult it is to raise the standard qualities of chains by individual enterprise. We may, in conclusion, say that we have now for some time allowed the largest portion of our ordinary cable works to remain idle rather than attempt to compete for a trade which, owing to the many encouragements tacitly held out to unscrupulous makers, is being gradually, but surely, ruined, and out of which we doubt if any honest maker can get even change for a sovereign, no matter how good his machinery may be. JOSEPH WRIGHT AND CO.

Tipton, February 23rd.

RIVER STEAMERS.

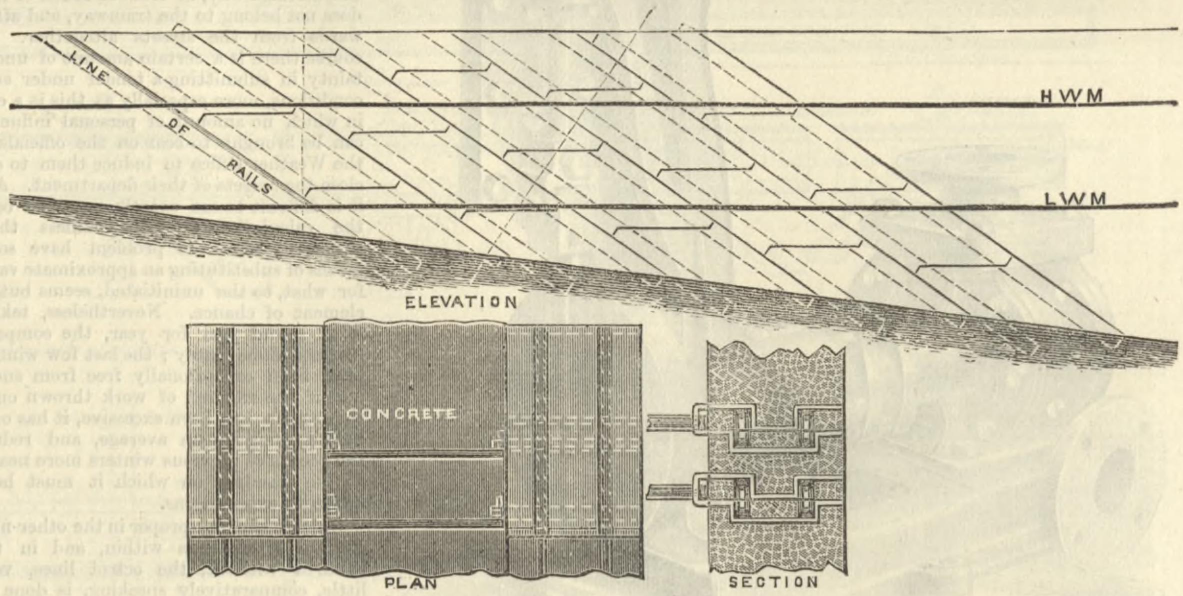
SIR,—In reading your interesting account of "Steamers for the Nile Expedition" in your issue of the 5th inst., allusion is made to the system of constructing steamers in separate pieces, and bolting them together at their destination.

As the following may interest some of your readers, I will, with your permission, describe a method adopted by me some years ago. In 1872 I designed a small steamer for the Upper Amazon River, which was built for me by Messrs. Priestman Brothers, Holderness Foundry, Hull. Length, 90ft.; beam, 12ft.; depth of hold, 4ft. 6in., in eight separate pieces. At one end of each piece was a strong inside angle iron and a bulkhead, at the other an angle iron only. They were sent by rail to Liverpool, and shipped in the s.s. Ambrose. On arriving at Para two pieces were, with the angle-iron ends joining, bolted together on the steamer's deck; the bolt holes in the bulkhead ends were plugged with wood. These two pieces, forming a complete watertight cistern, and capable of floating, were lowered into the water; the six other pieces were paired in the same way, making four floating sections in all. These were brought together in the water, the plugs punched out, and the bolts put in through the angle irons and double bulkhead, thus forming the hull with iron deck complete. The boiler was next lowered into its place, and all other fittings belonging to her, including deck cabins, paddle-boxes, and awning, all of which were of galvanised iron. The Ambrose arrived one day and left the next, but this was ample time to do what was required. I believe this to be the first steamer built on the system of bolting the sections together. J. M. SMALES, M.E.

Leavesden, Watford, Herts,
February 23rd.

CONSTRUCTING STONE OR CONCRETE PIERS OR BREAKWATERS.

SIR,—I shall be glad if you can find room for the enclosed in an early issue of your valuable paper. As will be apparent from the illustration, it is a proposal to construct piers or breakwaters without the use of cranes or other expensive machinery. It is proposed to form an inclined plane at the shore end of the pier or breakwater to be constructed, having two or more rails, as may be necessary, laid and secured firmly on its upper slope. The blocks of stone or concrete to have grooves on two opposite sides to the gauge and transverse section of the rails, which will thus serve the double purpose of guides, as the blocks slide into position by gravitation, and ties, to prevent any tendency to lateral displacement by the action of the waves. When one inclined course of blocks has been laid, rails to be placed in the prepared grooves for the next course,

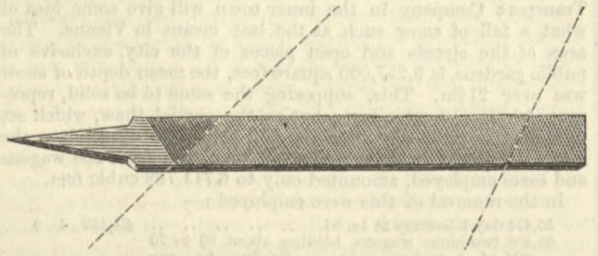


and so on. The rails may be made to dovetail into the blocks, giving greater strength and stability to the structure, or they may be withdrawn when the blocks are all in place, and the grooves filled up with cement or bituminous asphalte. Old railway rails could be adapted to the required purpose, as shown, readily, or stone guides might be used. The latter would not require removal, and their use would obviate any possible objection to the use of iron in such structures. The illustration shows the outer faces only, to be constructed of blocks, and the intervening space filled up by tipping in concrete; but it is easy to see that solid blocks might be used throughout, bonding with each other securely, as it is possible to give the blocks a good horizontal bearing. The adoption of this mode of construction for piers and breakwaters would reduce the special skilled labour and supervision now requisite to a minimum, and consequently reduce the cost, while avoiding any necessity for delaying the work in consequence of rough weather. W. GALLON, A.M.I.C.E.

Castle Chambers, High-street, Sheffield, January 13th.

MACHINE-CUT FILES.

SIR,—To detect machine-cut files, with a piece of chalk mark the angle of slope of the first cut on the file near the point, and again near the tang or handle end of the file, as shown, and if



the teeth run in exact parallel the file is machine cut. In cutting with the machines, the angle at which the chisel starts is maintained all the length of the file, and the cuts must in consequence be parallel—whereas, in hand work the hand of the workman moving radially with the wrist as a centre necessitates a slight deviation from the exact parallel in every tooth—creating a considerable divergence in the angle of slope on the length of an ordinary file. This deviation can be very readily detected by the eye on a hand bastard 14in., but holds equally good on narrow-pointed—flat—files; and, although not quite so plain to the eye, may still be easily detected by aggravating the length of the lines with two straight edges, as shown on the above illustration, and if the lines do not run parallel the lengthening of the lines will show the divergence at once. The above rule only applies to the first cut and not to the finishing cut, as the man's wrist works quite differently in this cut. If the finishing cut has been done by machine this can readily be detected by observing that the first few strokes at the point of the file will be of the same pitch of tooth as further up in the file; whereas the hand cutter for the first few strokes does not so strike so heavily, but, so to speak, feels his way gradually, and makes, consequently, finer teeth than when he gets further up into the body of the file. Many files are sent out with the first cut done by machine and the finishing cut by hand, so that the safest test is to try the first cutting angles, and not decide because the file is finished by hand that it is all hand cut. If both tests are applied absolute certainty can be had as to whether the file is entirely hand cut or not. Machine work in file cutting is, of course, more regular than hand work, but all practical users know this has nothing to do with the wearing property of the files, which are bought for use and not for ornament. Although it has been somewhat difficult in the past for users of files to detect the machine-cut file from its appearance, we do not believe there is so little difference in the wearing properties of the two files but that, when the matter is gone into, conclusively proves the superiority of the hand-cut file in wear. We produce hand work only, and may be considered prejudiced.

DICKSON BROTHERS AND CO.

Waverley Works, Sheffield, February 22nd.

REACTION WHEELS.

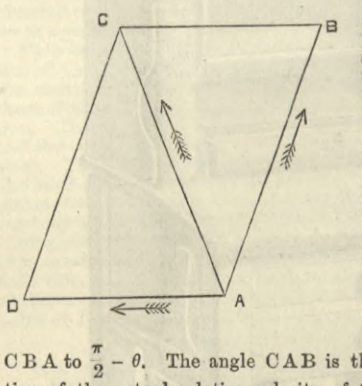
SIR,—I know by seeing your correspondence columns that "Pynx Gryph" is a voluminous writer. Probably also he is a great reader. The contents of his letters, and the conclusion he has arrived at from reading the description of angular velocity and the way to measure it, given in page 3 of Rankine's "Prime Movers," prove conclusively that, whether writing or reading, "Pynx Gryph" never thinks. However much I may differ with Rankine on other points, I agree with all he says about angular velocity.

If "Pynx Gryph" will substitute the works of Rankine for the name of Rankine, I admit freely the truth of his description of my feelings. I never either knew Rankine or had any written communication with him, so that I can feel neither good or ill-will towards him. All my acquaintances who did know Rankine speak of him in terms of the most affectionate esteem and respect, in which no doubt I should have cordially joined if I had had the pleasure of knowing him. Neither the writer of a book himself nor his friends should take offence at honest criticism. Does "Pynx Gryph" think my adverse criticism of Rankine's investigations on fluid impact unjustifiable?

"Pynx Gryph" now plainly states the assumptions on which his curve is constructed. The radial velocity of flow is to be constant and equal in value to the tangential velocity of the orifice. If "Pynx Gryph" had the slightest appreciation of the laws of hydro-mechanics he would know that he has indeed got himself into a "beautiful muddle." With your permission I will endeavour to make this clear to him. "Pynx Gryph" states that the area of the pipe is to be constant. Since the pipe is supposed to be running full the relative velocity must be constant. This being so, how can the radial absolute velocity be constant? In order that the latter may be constant, would it not be necessary that the areas of all sections of the pipe made by cylinders concentric with the axis of the wheel should be equal? They cannot be so if the areas of the sections made by planes perpendicular to the curve of the pipe are equal.

"Pynx Gryph" states the radial velocity, which is in accordance with his theory also the absolute velocity of flow, will be equal to that due to the net head of water. In order that this may be so, the area of the orifice of discharge must be equal to that of the pipe, and as the water is to leave the wheel with an absolute radial velocity equal to $\sqrt{2gh}$, it will have passed through the wheel without losing any *vis viva*. How then can it have lone any work?

In all descriptions of reaction wheels which I have seen, the tangent to the curve of the arm at its extremity, when a curved arm is used, is shown to be parallel to the tangent to the path of the orifice. "Pynx Gryph's" curve cuts this at an acute angle. The relative motion of water and wheel will be unaffected if we impress upon both the water and the wheel velocities equal and opposite to those of the wheel. At the distance ρ from the centre the relative velocity will have a component $= \sqrt{2gh}$ parallel to the direction of absolute radial velocity of outflow, and a tangential velocity equal to $\frac{\rho\sqrt{2gh}}{R}$. In the figure let A B A D represent in magnitude and direction the absolute radial velocity and the tangential velocity respectively. Complete the parallelogram A B C D, and join A C. Then A C will represent in magnitude and direction the relative velocity of flow. If A represents the angular interval between a radius corresponding with the direction of the absolute velocity and a radius passing through the point in the relative path distant ρ from the centre, the angle B A D will be equal to $\frac{\pi}{2} + \theta$, and the angle C B A to $\frac{\pi}{2} - \theta$. The angle C A B is the angle which the direction of the actual relative velocity of flow must make with the direction of the absolute velocity, and must therefore be equal to the angle, which the tangent to "Pynx Gryph's" curve at the point $\rho\ \theta$ makes with the same line of direction. Call it ϕ. We then have—



$$\frac{\sin. CAB}{\sin. ACB} = \frac{\sin. \phi}{\sin. \left(\frac{\pi}{2} - \phi + \theta\right)} = \frac{\text{tangential velocity}}{\text{absolute velocity}} = \frac{\rho}{R};$$

whence

$$\tan. \phi = \frac{\rho \cos. \theta}{R - \rho \sin. \theta} \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

A molecule of water has to describe the radial interval ρ in the time $\frac{\rho}{\sqrt{2gh_1}}$. Since this is also the interval in which the corresponding arc is swept out with the velocity $\frac{\rho\sqrt{2gh_1}}{R}$, we have

$$\rho\,\theta = \frac{\rho\sqrt{2gh_1}}{R} \times \frac{\rho}{\sqrt{2gh_1}} = \frac{\rho^2}{R}.$$

so that the polar equation to "Pinx Gryph's" curve is $\rho = R\,\theta$, the absolute radial path being the initial line and the pole at the centre of the wheel. Now, the angle which the tangent to the curve at any point $(\rho\ \theta)$ makes with the initial line is equal to the sum of the angle θ plus that of the angle between the tangent and the radius vector, which is equal to $\tan.^{-1} \rho \frac{d\theta}{d\rho} = \tan.^{-1} \frac{\rho}{R}$, and we have for the corresponding value of ϕ the equation

$$\tan. \phi = \tan. \left(\theta + \tan.^{-1} \frac{\rho}{R}\right)$$
$$= \frac{R \sin. \theta + \rho \cos. \theta}{R - \rho \sin. \theta} \quad . \quad . \quad . \quad . \quad (2)$$

which is more than double the value given by equation (1). Since the angle at which the radius vector cuts the tangent to the curve is equal to $\tan.^{-1}\frac{\rho}{R}$, this angle at the extremity is equal to 45 deg., and therefore the tangent to the curve also cuts the path of the orifice at an angle of 45 deg.

If "Pynx Gryph" cannot detect any error in these calculations, he ought in your next issue candidly to acknowledge:—(1) That the curve designed by him would not allow the water to flow out in a straight line when the wheel is moving at the assigned velocity; (2) That if it did, no work would be done by the issuing water itself, and that therefore the rotation of the wheel must have been caused by some other force than that of the water.

"Pynx Gryph's" belief that the water in the experiments to which he refers did not rotate must be due solely to errors of observation. Has "Pynx Gryph" taken the trouble to calculate what would be the central dip in the experiments to which he refers? It might be too small to admit of easy detection.

I do not assume certain things to be true which other engineers maintain are not true. I have given demonstrations that certain things are true, and no engineer has as yet been able to find a flaw in those demonstrations. Why does not "Pynx Gryph" tackle my demonstration that the relative velocity after impact is not equal to the relative velocity before impact?

If "Pynx Gryph" will think again over his challenge he will see that he has proposed an absurdity. Experiments proving that certain turbines working drowned do not give more than 50 per cent. efficiency, do not prove that turbines cannot be designed which will give 70 per cent. efficiency. In my work on water wheels I have pulled to pieces Professor Thomson's calculations on the results of the Ballysillan test. Why does not "Pynx Gryph" endeavour to prove that Professor Thomson is right and I am wrong?

WILLIAM DONALDSON.

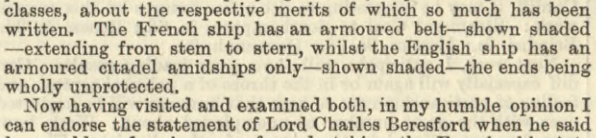
2, Westminster-chambers, February 22nd.

UNAPPROVED ARMOUR-CLADS.

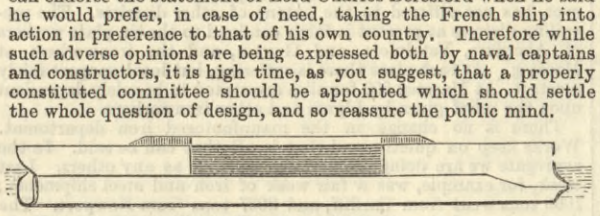
SIR,—Your article on the above in last week's issue, showing as it clearly does the weak points in the design of the two projected armour-clads Nile and Trafalgar, will, I trust, aid materially in directing public attention to this all-important subject; for upon a comparison being made between the latest types of vessels either built or building in our dockyards, with those of several European Powers, it is apparent that our ships are not the most formidable afloat, as is fondly imagined by nine-tenths of our countrymen, but are decidedly inferior, alike in size, thickness of armour, and weight of guns.

In addition to the cases cited by you last week of the two Italian ships Italia and Lepanto, there are several French ships of the Formidable type, which exceed in those points the latest of our Admiral class, viz., the Camperdown. This will be seen by the particulars and accompanying sketch, representing the two classes, about the respective merits of which so much has been written. The French ship has an armoured belt—shown shaded—extending from stem to stern, whilst the English ship has an armoured citadel amidships only—shown shaded—the ends being wholly unprotected.

Now having visited and examined both, in my humble opinion I can endorse the statement of Lord Charles Beresford when he said he would prefer, in case of need, taking the French ship into action in preference to that of his own country. Therefore while such adverse opinions are being expressed both by naval captains and constructors, it is high time, as you suggest, that a properly constituted committee should be appointed which should settle the whole question of design, and so reassure the public mind.



H.M.S. CAMPERDOWN



H.M.S. FORMIDABLE

	Formidable.	H.M.S. Camperdown.
Length	342ft. 6in.	330ft.
Breadth	70ft.	68ft. 6in.
Displacement..	11,159 tons..	10,000 tons.
Armour:—		
	Steel belt from stem to stern varying from 21⅝in. in middle to 13¾in. at ends, armour deck, 3⅛in. at ends, 4in. over machinery, 3 barbettes cased with steel plates 15¾in. thick.	Steel faced belt amidships 16in. and 18in. thick, protective deck, 2½in. thick, 2 barbettes cased with 14in. plates.
Armament:—		
	3 75-ton, 12 5½in., 10 Hotchkiss guns.	4 63-ton, 6 6in., 12 6-pounder, and 4 Gatlings.
Indicated horse-power	9000	9800
Speed, estimated	15½ knots.	16 knots.

London, N.W., February 23rd.

Q.

ROTARY ENGINES.

SIR,—Although your correspondent, "Long Connecting Rod," in his letter of January 15th invites discussion of this subject, neither he nor any other reader has thought fit to notice my letter in your issue of the 5th inst. This is disappointing, especially in the face of the excellent article on "Rotary Engines" which appeared in the same impression, and would lead one to suppose either that a very persons appreciate the great advantages attendant upon their use, or that such a discussion is objectionable to those interested in high-speed engines of other types.

Of the device put put forward by a correspondent in your current issue as a "truly rotary engine," I should like to say a few words, because if the gentleman who signs himself "H." truly believes what he has written, his ideas of rotary and reciprocating motions must be very strangely mixed. To begin with, he claims to have in the machine he describes an engine in which "all the parts move in circles at a uniform velocity," which, he says, may at first sight appear impossible; and I confess that so far as this particular device is concerned, neither first nor second sight has enabled me to see in it anything but an impossibility. Let us suppose the diameters of the circles described by the crank pins to be 1ft. It is then evident that the cylinders A A^1 move from right to left a distance of 1ft., and back again 1ft., while the crank pins are traversing the circumference of the circle, viz., 3·14ft.—that is to say, the crank pins move through a distance about one-third more than the pistons in a given period of time. Will your correspondent kindly explain how this is accomplished if, as he says, all the parts move with a uniform velocity? He also claims that the alternate acceleration and retardation of the moving parts is here entirely overcome, but I fail to see how a piston, or indeed any mass, which is driven by a force alternately acting from opposite ends, can by any possibility have a uniform velocity, any more than that a point can travel in a straight line and in a circle at one and the same time. The fact of the cylinder and piston swinging round during the stroke does not, in my opinion, contribute to this state of things, any more than the fact of a marine engine being tossed about in a rough sea would influence the conditions of changing a reciprocating into a rotary motion.

I am unable to inform your correspondent whether or not his idea is new; but so far as can be seen, I fear it is far from possessing the essential features of a "truly rotary engine," and even as a reciprocating engine, although there are grouped together four pistons in a very small space, it still retains an objectionable feature, viz., a dead-point, which would not be allowed to exist in any properly constructed engine of the latter type having more than one piston.

A truly rotary engine must have its piston, or equivalent, always acted upon in one direction; must have its centre of motion and centre of gravity at one common point; must have no dead-point, and must be constructed to reverse quickly; and when such an engine is forthcoming without the well-known objections hitherto encountered, great economy is certain to result.

February 23rd.

LONG STROKE.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, February 13th.

THE utmost interest is felt in the talked of syndicate among the Trunk lines in reference to the anthracite coal traffic. Several combinations are talked of in railroad circles. The syndicates controlling the reorganisation of the Reading have agreed on essential points, and the work of righting complications of that road is progressing satisfactorily. The purpose of the reorganisation, besides lifting the road out of its financial distress, is to come into harmonious relations with the Pennsylvania Railroad Company. The syndicate is also undertaking to establish harmony between the anthracite coal interests. The Reading is interested in the great combination. It is also intended to exercise control over the soft coal traffic. It is rumoured the syndicate represents 500,000,000 dols. of capital, although it is probable this is far in excess of the actual capital interested. The Pennsylvania Company has for years contemplated the securing of the Reading properties. So far the anthracite combination has made no practical progress towards a combination, and is waiting for the settlement of the railroad question. The managers of the various Trunk lines and coal interests recognise that no possible patchwork can maintain interest, and that nothing but a syndicate uniting all divergent interests will be sufficient. The opinions of leading brokers are not in accord as to the possibility of such a syndicate, or of the permanency of any such combination even if accomplished.

The difficulty between the Pennsylvania and the Baltimore and Ohio companies is still unsettled. The presidents of the various trunk lines have been endeavouring to establish a division of east bound freights, but have not yet succeeded. Everything is in an unsettled condition, as regards railway traffic, but the money interests are not alarmed, feeling that the details can be harmoniously adjusted in time. The iron houses report a great deal of inquiry for old material and scrap, and orders are far in excess of supply. Inquiries are in hand this week for large quantities of Bessemer and Spiegeleisen, but at present prices no contracts will be placed. Inquiries are in hand also for between 60,000 and 70,000 tons of steel rails, one-third of which is wanted in the South, and the balance in the Middle and Western States. The rail makers will not increase production at present. The wrought iron pipe makers held a session in Pittsburgh yesterday, and resolved upon a slight advance in prices. The nailmakers in the West will confer with their workmen. Crude iron of all kinds is firm, and prices are upward in tendency. Bars, plates, and sheet iron are firm, but only in moderate demand. Bridge building requirements are coming in, and contracts for large amounts will be placed during March. Two new rolling mills are to be built, and blast furnaces throughout Pennsylvania are to be put into better repair for an increased production.

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

(*From our own Correspondent.*)

THE newest item of trade this week is that the Ettingshall Ironworks, near Bilston, the property of the Barbor's Field Iron Company, are about to be re-started. They have been acquired on a long lease by the Birchills Hall Iron Company, Walsall, and will be set going on black sheets. The works comprise four sheet mills and a considerable forge. The re-start of this concern is another evidence of the desire by galvanised sheet-makers to become their own black sheet makers also.

Preparations are being pushed forward by the Wolverhampton Corrugated Iron Company, and Mr. E. Farnworth, who will trade under the title of the Shrubbery Iron and Steel Company, for the early re-start of the Shrubbery Ironworks, Wolverhampton, and which I some weeks ago reported had been taken over for black sheet iron manufacture.

Messrs. G. Adams and Sons, of the Mars Ironworks, are also losing no time in the laying in of their new plant and machinery with which they intend to enter into the galvanised sheet business.

The Victoria Ironworks, Moxley, near Wolverhampton, which form a section of the works formerly in the occupation of Messrs. David Rose and Sons, are about to be started upon small rounds and merchant bars by Messrs. Simcox and Horton, two practical ironmakers.

From the reports brought to 'Change in Wolverhampton yesterday and in Birmingham to-day, it was evident that more sheet orders might be obtained if makers were prepared to accept all the inquiries which are reaching them. Common singles for merchant purposes are freely offered at £6 2s. 6d. upwards, but some consumers are attempting to buy below this. The minimum quotation for galvanising singles is about £6 5s., and doubles are plentiful at £6 10s. upwards.

Some of the best markets at date for best thin sheets are the Australias, Canada, and certain of the continental countries. Quotations keep at £10 to £11 for working-up qualities, and £11 to £12 for stamping sorts. But actual selling prices are less than this.

As to marked bars, the standard quotation of £7 10s. per ton remains in force, but other bars of very good quality can be purchased at £6 to £6 10s., whilst common iron is obtainable for £5 at the works.

Strip iron is selling at, for common qualities, something less than £5, and common hoops may be had at £4 17s. 6d. up to £5 5s. Instances were related this—Thursday—afternoon in which firms who had lately quoted £5 10s. for a certain class of merchant iron, and had, as they thought, made sure of the order by their low price, found that the contract was actually placed at £4 15s. per ton! Yet for this same iron some twelve months ago £6 10s. was being obtained.

Stocks of pig iron are mostly large. Quotations for all-mine, hot-air, pig iron stand at 55s., 57s. 6d., and 60s. per ton, according to quality; part-mine, 45s. and 46s. 3d.; common iron, 35s. and 37s. 6d. per ton. Actual selling prices for first and second-class sorts are, however, generally 2s. 6d. per ton under these quotations, and for common iron 2s. 6d. to 5s. per ton. Hematites occupy the stronger position on the market at 53s. per ton.

The managers of the Associated Collieries upon Cannock Chase have held a meeting to consider the advisability of serving the men with notice for a reduction in wages. The bulk of the meeting were, however, not favourable to the proposition, and the matter stands over for further consideration.

A charge of dynamite which was being used in removing the lining of a converter at the Spring Vale Steelworks, Bilston, of the Staffordshire Steel and Ingot Iron Company, unexpectedly exploded on Monday, and caused serious injuries to two men. One of them has since died. The only explanation of the accident which is yet feasible is that the converter had been in active operation on Saturday and had not cooled down sufficiently to allow of the removal of the lining being carried on with safety.

Several constructive engineering firms in this district are awaiting the letting of a contract from the Indian State Railways involving something like 6000 tons of ironwork mainly of the bridge and roofing order. Amongst engineering firms generally here the opinion seems to be that there is plenty of work about, but the complaint is that prices still continue so low as to make its acceptance scarcely profitable. Specifications are just now out for a good deal of railway bridge work; one railway company is asking for something like 1800 to 2000 tons of ironwork. Engineering firms are tendering freely, and it is not at all unlikely, from what I hear, that the work may come into this district.

Up to quite recently some South Staffordshire exceptional engineering firms have been kept active upon home orders for railway crossings and dredger work. On castings for engines and machines of various descriptions other firms are at date having a fairly good run.

That part of the ironwork of the recent Antwerp Exhibition structure that recently went down in the Mersey whilst in transit to Liverpool was fully insured. Some parts of it have been recovered, and the mishap will, fortunately, cause little loss to the contractors—a James Bridge firm—and but little hindrance in the completion of the Exhibition at Liverpool. As the week closes, scientific evidence is expected to be forthcoming as to the cause of the recent accident on the site of the new structure, since several engineering experts have given their attention to the matter.

The London and North-Western Railway Company is making considerable progress with the necessary arrangements for carrying out the proposed alterations to the Smethwick stations. The work, it is expected, will be commenced in April.

The makers of cultivating tools for export are better off as regards the amount of trade doing than many other manufacturers. South American orders are numerous, and the Australian market is moderately active. There are a good many inquiries from India, chiefly for tea-planting tools, and Messrs. Edwards and Sons, of the Griffin Works, Wolverhampton, have some good lines for their special make of this class of goods.

Reports sent home by hardware travellers in London and certain of the large provincial centres testify unmistakeably to the severity of continental competition in certain of the industries. Careful manufacturers are here and there possessing themselves of patterns of imported goods, with the view of imitating them as nearly as may be.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—No improvement is still the report from all branches of the iron trade; and, so far as anything really in prospect is concerned, there seems to be no probability of any variation in the report for some time to come. It is scarcely possible that the condition of trade can get very much worse, unless there is to be some serious commercial disaster. Not only are prices lower, but there is also less business doing than during the most severe depression of 1879, and the long-continued depression is becoming a severe strain upon both makers and manufacturers of iron. The excessively low prices at which both pig and finished iron are now being offered still fail to stimulate business, and apparently offer little or no inducement to buyers to anticipate even probable requirements, and transactions are mostly limited to simply hand-to-mouth necessities. Occasionally, buyers, when giving out orders for present requirements at the minimum figures they can get makers to accept, offer to increase their orders by forward deliveries over an extended period. But makers, although eager enough for present orders, are not very anxious to commit themselves very far ahead at the unremunerative rates now ruling in the market; and the fact that offers such as these have been declined may be taken as some indication of a belief that prices are not likely to get very much lower. The probability of any material advance, on the other hand, seems for the present to be even still more unlikely, and the prospects for the future continue very discouraging.

There was about the usual attendance at the Manchester Iron Exchange on Tuesday, and about the usual absence of any weight of business doing that has characterised the market for some time past. In Lancashire pig iron business to a small extent has been done at about 37s. 6d. to 38s., less 2½, for forge and foundry qualities delivered equal to Manchester. For district brands prices are very irregular, and there is a margin of quite 2s. per ton between the quotations of different brands. The average current prices in the market are about 37s. 6d. to 38s. 6d., less 2½, delivered here, but there is very little business being done, and even where sellers in some instances are willing to accept fully 6d. to 1s. per ton under these figures, they complain that they are unable to secure orders. The excessively low prices now ruling for outside brands, which in the case of Middlesbrough iron are lower than have ever been known before, also fail to attract buyers here, and there is comparatively little or nothing doing either in Scotch or North-country iron.

During the past week there has been scarcely any inquiry at all for hematites, and prices have really not been tested, but there is no doubt orders could be placed at from 51s. 6d. to 52s. 6d., less 2½, according to quality, for good foundry descriptions delivered here.

A very despondent tone prevails in the manufactured iron trade. There are no orders of any bulk given out, and where there is any buying going on it is in small driblets from hand to mouth, which scarcely keep the forges going half-time. The average basis of prices remains at about £5 2s. 6d. for bars, £5 10s. for hoops, and about £6 10s. for local made sheets, delivered into the Manchester district, but many of the makers are so anxious to secure orders to keep their works going, that for actual specifications to be put in hand at once they are prepared to give way 2s. 6d. per ton upon these figures.

The engineering branches of industry remain in much the same condition as reported last week, but it may be mentioned that here and there, although there is no actual improvement, the belief is entertained that the worst has been passed.

The annual report of the Steam Engine Makers' Society will be ready for issuing to the members at the close of the present week, and I have been furnished with a short summary of the principal matters with which it will deal. So far as the financial position of the society is concerned, the report will show what may be regarded as very favourable results considering the exceptionally depressed state of trade, and the heavy calls, which, as a consequence, have been made upon the funds. The society has been able to pass through the year and meet all its liabilities with a loss on the twelve months' working of only a little over £600. As regards members, there has been a small but satisfactory increase, the society being able to record an addition of about 150 to its membership, whilst the fact that there has been no increase in the arrears of subscriptions as compared with the previous year, shows that even with the bad times the society is not losing the support of its old members. In the expenditure during the past year the payment to unemployed members has been the most serious item, and this has been equal to about £1 per member, being an increase of 7s. 6d. per member on the previous year. The first half of the year showed a slight saving on the society's operations, but the extreme depression in trade which subsequently set in, accompanied with the large increase in the number of members thrown on the books for out-of-work support very soon brought about an outlay in excess of the income, which, as already intimated, during the second half of the year amounted to upwards of £600.

Mr. Miles Settle, of Darcy Lever, near Bolton, the inventor and patentee of the new water cartridge for blasting in mines, which has recently undergone a number of completely successful tests under all manner of trying conditions, is perhaps one of the best known mining engineers in Lancashire. Certainly he has had more practical and personal experience of disastrous explosions in mines—one very prevalent cause of which it is the object of his invention to remove—than any other mining engineer in the kingdom. Mr. Settle has been present at no less than nineteen explosions or accidents in mines; and on eleven occasions he has been brought out of the pit so severely injured that his recovery has been considered almost hopeless. Indeed, on the last occasion, the explosion at the Lycett Colliery, Newcastle-under-Lyme, when Mr. Settle had bravely descended to assist in rescuing the men, he was actually reported as killed by the second explosion which took place in the mine, and short obituary notices were published in the Bolton papers. Although very seriously injured, Mr. Settle again recovered, and has since added something more to the usefulness of his life by the invention of the new water cartridge. For his bravery in assisting to rescue the injured at explosions, several public presentations have been made to Mr. Settle; and having been so much brought into personal contact with the perilous conditions under which mining is carried on, Mr. Settle has for many years past devoted his attention to arriving at some method by which the danger arising from the firing of shots might be removed. He was the first to introduce what is known as the "lime cartridge," in 1874; but finding that this was too slow in its operation to become a substitute for gunpowder, he has since turned his attention to some means of extinguishing the flame of the ordinary shot before it could communicate with any explosive atmosphere that might have accumulated in the workings of the mine. The result has been the water cartridge, which is a very simple contrivance, consisting merely of an outer casing of some waterproof material, in which the cartridge is placed and supported in the centre by a couple of discs, so that it is completely surrounded by a jacket of water when the outer casing is filled. The water cartridge, when placed in the shot hole, is fired by electricity from a small portable hand battery. Tests have been made with the cartridge at several collieries with eminently satisfactory results. Cartridges containing gelatine dynamite have been fired in the most explosive mixtures of gas, and on three several times in full barrels of gunpowder, without communicating any flame from the cartridge either to the gas or the gunpowder. Mr. Settle has placed the working of his patent in the hands of Nobel's Patent Explosive Company. Some opposition has been raised to the validity of the patent, which is being contested; but in any case, the water cartridge which Mr. Settle has introduced cannot fail to add another important step towards removing the dangerous risks which have surrounded mining operations.

In the coal trade the continued cool weather still maintains a freely good demand for house-fire consumption, and the pits generally are kept on pretty near full time, with the output of the better qualities of round coal moving away freely. Common round coals are, however, very bad to sell, and most of the collieries are so burdened with stocks that sales are pushed at excessively low prices. Engine classes of fuel are meeting with more inquiry from some districts, chiefly in East Lancashire, where in the cotton centres there seems to be more activity, whilst the probability that the wages question in the Oldham district will for the present be allowed to drop, removes what has hitherto been a disturbing element in the trade. In the Wigan district the supplies of good slack are at some pits getting rather short, but generally there is plenty of engine fuel in the market. At the pit mouth best coal remains at about 8s. 6d. to 9s.; seconds, 7s. to 7s. 6d.; common house coal, 5s. 6d. to 6s.; steam and forge coals, 5s. to 5s. 6d.; burgy, 4s. to 4s. 6d.; good ordinary slack, 3s. to 3s. 6d., with best sorts fetching in some cases 3s. 9d. to 4s. per ton.

In the shipping trade house-fire coals are going away pretty freely, but for steam coals there is only a very slow demand, and ordinary qualities do not average more than 7s. to 7s. 3d. per ton delivered at the high level, Liverpool, or the Garston Docks.

Barrow.—I am not in a position to give a satisfactory report this week of the condition of the hematite pig iron trade of this district. The demand is very quiet indeed, and the position of trade is not much better than it was prior to Christmas, when it will be remembered a spurt was experienced on American account. The fact of the matter is that at present makers are not offering to sell, and it is only in cases where holders of heavy stocks of iron are compelled to negotiate purchases that sales are made, and those at a price which makers generally are indisposed to transact business at. The value of iron is not so firm as it has been of late, and mixed parcels of Bessemer are quoted this week at 43s. 6d. per ton net at works, for prompt delivery net, with No. 1 at 44s. 6d. per ton, and forge and foundry iron at about 41s. 6d. per ton. Sales at this latter quotation have been few in number, indeed the sale of the commoner qualities of iron is now very much restricted, inasmuch as the demand has so materially fallen off that makers have reduced their output of forge and foundry iron to 5 per cent. of their entire production. Hopes are experienced that a revival will soon be established with America so far as the pig iron trade is concerned. It is confidently expected that good spring orders will be booked for America for delivery in the spring and throughout the season, in order to enable American producers of steel to make the 700,000 tons of rails which are said to be wanted in the country during the current year. Stocks of iron in the Furness district have not increased during the past six months, except perhaps in one instance, and that to not a very large extent, but in West Cumberland there has been a large increase in stocks, and it is noteworthy that upwards of 100,000 tons of iron have been stored in warrants. Steel makers are not receiving any new orders of moment, and the demand has of late fallen off very much. The heavy orders which have lately been booked are for forward delivery. A fair trade is doing in tin bars, and some good orders have been placed for Siemens angles and plates, for which purpose the plant at Barrow is being considerably extended. Engineers are doing a quiet trade. The strike at Barrow has been settled by the men accepting a reduction of 6d. per week in their wages. Iron ore is quiet at from 8s. 6d. to 11s. per ton at mines. Coal quiet and steady. Shipping very inactive.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

A SLIGHT dispute has been pending at the Thorncliffe Ironworks —Messrs. Newton, Chambers, and Co.,—for some time. It only affected the engine fitters and blacksmiths in the ironworks department. The dispute has now been settled by the management meeting the men half-way. Mr. George Dawson, managing director of the department, stated that if the state of trade three months hence warranted it, he should be willing to concede the half now taken. The men, considering the offer reasonable, accepted it.

A series of conferences have been held in connection with the Building Trades Exhibition by the Society of Architects, meeting at the Artillery Drill Hall, Sheffield. Belgian *v.* English iron came in for a large share of attention. Mr. Butson, a London architect, strongly urged upon engineers, architects, and others having control over works, especially public works, the expediency of inserting binding clauses in their contracts that no goods of foreign manufacture, unless specially specified, should be used upon their works under pain of a heavy penalty. Mr. W. C. Fenton, building inspector for the Sheffield Corporation, stated that although he had seen a great many girders used in buildings in and out of Sheffield, he could not say that he had ever yet come across an English girder in an English building. Mr. Fenton expressed regret that English firms did not lay themselves out to produce girders that would be within the reach of English architects and builders. In the cases of three large extensions of buildings there was not an English girder used; but a great portion of the girders used in the new Sheffield Sewage Works had been made at Barnsley. It was stated that English steel girders are being largely used for warehouse building on the London and Tilbury line; almost all railway work, it was stated, was of English manufacture, because it had to be subjected to tests under which the Belgian work broke down. English companies have now been established at Middlesborough and Darlington for the manufacture of girders, and it is stated that they can be produced as cheaply here as in Belgium, in spite of the low wages and long hours prevalent on the Continent. An authority assures me that the pig iron sent from Cleveland to Belgium is largely used in this business, and the double carriage they paid to take the raw material to Belgium, and bring the manufactured goods back to England, ought to be a point in favour of English makers.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

DURING the past week Cleveland pig iron has still further fallen in value. At the market held on Tuesday last merchants were offering No. 3 g.m.b. for prompt delivery at 30s. per ton, or 6d. per ton less than they were willing to take the previous Tuesday. A good many sales were effected by them at this figure, but makers declined to follow suit, as most of them are working at a loss. The prospects of the trade are certainly most discouraging, for although the shipments are better, stocks are still increasing. The continuance of the shipbuilders' strike contributes not a little to this result, and the probability of a further fall in prices makes consumers reluctant to buy more than they need for immediate use.

At Middlesbrough warrants are offered at 30s. per ton, but as little as 29s. 9d. has been accepted at Glasgow.

The increase in the stocks at Messrs. Connal and Co.'s stores last week were as follows:—At Middlesbrough, 2100 tons; at Glasgow, 1633 tons.

Shipments of pig iron from the Tees are improving. Up to Monday night 41,064 tons had been sent away, as against 34,712 tons in the corresponding portion of January.

Nothing new has occurred in respect of the finished iron trade. Few inquiries are in circulation, and makers continue to quote the same prices as have been current for some weeks past. Buyers are generally of opinion that less should be taken now that pig iron has further fallen, and they give out their orders only in a hesitating manner.

It is reported that Messrs. Armstrong, Mitchell, and Co. have secured an order from the Spanish Admiralty for two cruisers, which are to be completed by the summer of next year.

The negotiations between the employers and operatives connected with the shipbuilding industry seem to have made some progress towards a settlement. A conference between the representatives of the two parties to the dispute took place at Sunderland on the 18th, under the presidency of Mr. James Laing. The operative delegates expressed their willingness to accept reductions varying from $2\frac{1}{2}$ to $7\frac{1}{2}$ per cent., according to the nature of the work, instead of the 10 to $12\frac{1}{2}$ per cent. originally demanded by the employers. After four and a-half hours of discussion and repeated *ex parte* consultations, the employers handed to the delegates the following resolutions, which they had passed unanimously, viz.:—"The Tyne and Wear shipbuilders, having carefully considered the proposals made to them by the men, regret that they are unable to agree to them, as being impracticable; nor can they see their way to accept less than their former offer of 10 per cent. off the higher-paid men. But being willing to make another effort with a view to a settlement, they have resolved to accept the following modified reductions:—Off piece-work prices—Platers, 10 per cent.; angle-iron smiths, 10 per cent.; rivetters, $7\frac{1}{2}$ per cent.; caulkers, $7\frac{1}{2}$ per cent. Off time wages, 2s. per week. The employers still express their willingness to consider any particular cases in each department in which the reductions would prove unequal, both parties being at liberty to bring forward cases, the number to be mutually agreed upon. The reductions are to apply to repairing work, as usual." The chairman added that unless these terms were accepted, the employers would open their gates to the multitudes of unemployed workmen who were always about their gates clamouring for work.

The depressed state of the Cleveland iron trade, so far at least as pig iron is concerned, will be appreciated when the following transaction is known. A Cleveland smelting firm made a contract last week to supply several thousand tons of No. 3 foundry and No. 4 forge iron. The price agreed on for the former was 30s. 3d., and for the latter 29s. $2\frac{1}{2}$d. per ton, f.o.t. or f.o.b. at smelter's works, net cash the Monday after delivery. This was about the lowest sale on record when it was made, but since it was made the price has fallen 3d. per ton lower.

The extensions to the Middlesbrough Docks, belonging to the North-Eastern Railway Company, are fast approaching completion. Nine months is now spoken of as the interval required for completion. The dock itself will be about 40ft. deep, and the entrance lock about the same. The construction of the latter has been seriously retarded by beds of quicksand, but this and other difficulties are now mostly surmounted. The channel from the river to the dock entrance has been widened as well as deepened, and a width of 230ft. and a maximum depth of 30ft. may be relied on. A timber quay wall, secured by piles, defines this channel throughout its whole length and on both sides. The quay walls of the dock itself are of ashlar, and are nearly complete. The contractor for the work is Mr. John Jackson.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE has been less business doing in the speculative department of the Glasgow pig iron market this week. By heavy selling last week prices were depressed to 38s. $1\frac{1}{2}$d. on Friday, but the quotations were a little better this week. The inquiry, both home and foreign, is on a limited scale, but it is expected that the shipments will exhibit some improvement in succeeding weeks. During the past week they amounted to only 5866 tons, as compared with 7852 in the preceding week and 6689 in the corresponding week of 1885. The amount of pig iron sent into the warrant stores is below what has been usual of late. At present there are 94 furnaces in blast, as against 92 at this date last year.

Business was done in the warrant market on Friday at 38s. $1\frac{1}{2}$d. to 38s. $4\frac{1}{2}$d., and on Monday the transactions were at 38s. $2\frac{1}{2}$d. to 38s. 4d. Tuesday's market was quiet at 38s. $4\frac{1}{2}$d. to 38s. $2\frac{1}{2}$d. cash. On Wednesday the market was much depressed, with business down to 38s. cash. To-day—Thursday—in consequence of a proposal to restrict output, quotations advanced to 39s. $1\frac{1}{2}$d., closing with buyers at 38s. $10\frac{1}{2}$d. cash.

The market quotations of makers' iron are again somewhat lower, as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 43s.; No. 3, 41s.; Coltness, 47s. and 43s. 6d.; Langloan, 44s. 6d. and 42s. 6d.; Summerlee, 47s. 6d. and 43s.; Calder, 47s. and 41s.; Carnbroe, 43s. and 40s. 6d.; Clyde, 44s. and 40s. 6d.; Monkland, 39s. and 36s. 6d.; Quarter, 38s. 6d. and 36s.; Govan, at Broomielaw, 39s. and 36s. 6d.; Shotts, at Leith, 46s. and 45s. 6d.; Carron, at Grangemouth, 48s. 6d. and 45s. 6d.; Kinneil, at Bo'ness, 43s. and 42s. 6d.; Glengarnock, at Ardrossan, 43s. 6d. and 41s.; Eglinton, 39s. and 37s.; Dalmellington, 41s. 6d. and 39s.

In consequence of the very low rates now prevailing for all kinds of pig iron, the Scotch ironmasters have been discussing the propriety of combining to reduce the output and the wages of ironstone miners and blast furnacemen. There is some probability of the railway charges and royalties paid to landlords being also considered with the object, if possible, of obtaining much needed modifications. The impropriety of the same royalties being paid now as were exacted when iron was three times its present price is the subject of common observation among those connected with both the iron and coal trades. In the meantime a reduction of wages is believed to be inevitable.

One blast furnace has been put out at Shotts, and one lighted at Calder, and there are now 94 in operation, as compared with 92 at this date last year.

The arrivals of Middlesbrough pigs into Scotland in the past week have been 6015 tons, the total received since January 1st having been 38,277 tons, or 14,450 tons less than in the same time last year.

During the past week there was shipped from Glasgow £4500 worth of machinery, £4600 steel goods, and £30,100 worth of general iron manufactures.

There has been a considerable improvement in the shipping department of the coal trade. The past week's shipments were, at Glasgow, 27,336 tons; Greenock, 1612; Ayr, 7251; Irvine, 2778; Troon, 7099; Leith, 4706; Grangemouth, 3439; and Bo'ness, 1838 tons. This total of 56,059 tons, which does not include the shipments from Burntisland, is fully 14,000 tons larger than the quantity despatched from the same ports in the third week of February last year. The prices continue very low, and three or four weeks will yet elapse before we shall have entered upon the busy part of the spring season.

The Drumair pits at Dreghorn in Ayrshire have been at least temporarily closed by Messrs. Merry and Cuninghame, in consequence, it is said, of a dispute with the owner of the ground. A new shaft, with engines and other gear, was nearly ready for working. About forty men are thrown idle.

Throughout the West of Scotland the colliers have all acquiesced in the withdrawal of 6d. a day from their wages, and a second reduction of a like amount is now talked of as probable at an early date.

Representatives of coalmasters and miners met in conference at Dunfermline this week with reference to a reduction of 10 per cent. which was made in the wages on Monday.

Mr. Joseph Swan, the inventor of the Swan electric light, has delivered an address to the Philosophical Society of Glasgow, on "An Electric Safety Lamp for the use of Miners." He claimed for his lamps absolute safety in an explosive atmosphere.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

IN coal matters there is a slight lifting of the cloud as regards some varieties of coal, but generally a good deal of depression exists. I hear of collieries working one and two days a week, and prices accepted for best coal entailing a loss upon the coalowners. With several of the large coalowners the question is, which entails the greater loss, stopping the colliery, or accepting offers at low prices, and I am confident that in many instances humanity turns the scale.

Shipping at all the ports has been better. Cardiff sent away last week 139,499 tons of coal foreign, as compared with 96,694 tons the previous week. Newport, 34,590 tons, as compared with 31,797. Swansea sent away 26,300 tons of coal in round numbers, showing a decidedly busy week.

Small steam coal is more active, and prices obtained are from 4s. to 4s. 6d. No. 3 coal is also in better demand.

A Barry Dock Land Company has been started by some of the Cardiff architects, builders, and others.

As showing the lowness of chartering transactions at present in Cardiff, it may be interesting to cite a few fixtures of this current week:—Steamers: Coal to Southampton, 5s. 6d.; Rouen, 5s. 9d.; Brindisi, 9s.; Messina, 9s. 3d.; Havannah, 9s.

Next week, I anticipate, will show poor trading results. Cardiff especially will again be in the throes of a political contest, and feeling of partisanship runs so high that business will be neglected even with the great number of unemployed about. Work, however, has not suffered to the extent of other districts. The prevailing distress at present is fairly confined to the tin-plate workers of Aberdare, Ystalyfera, and Gurnos, and the ironworkers at Maesteg. At each place there is suffering, but local support fairly meets it. At Maesteg 500 families are stated to be solely dependent upon the relief given by Llynvi and other ironworkers.

There is no change in the manufactured iron department. Works keep on quietly, and that is all that can be said. In the aggregate we are doing, I dare say, as well as any others. Last week, for example, was a fair week of iron and steel shipments; 1008 tons went from Cardiff, and 3037 tons from Newport. The destinations of the principal were:—Townville, 1073 tons; Rockhampton, 1271 tons; and Paysandu, 693 tons.

Iron imports included a good cargo of pig from Middlesbrough. In iron ore the Tredegar Iron Company received a large quantity last week, and the total cargoes, principally from Bilbao to Cardiff and Newport, were considerable. I hope this is a good sign. A more spirited movement is badly wanted in the rail trade, and orders to rail China and Burmah would be hailed with delight.

The tin-plate trade is brisk, even if it is not quite so profitable as makers would wish. January totals, for instance, from Swansea were 25,000 boxes over January, 1885, and 30,000 boxes over January, 1884. Last week's business was good, the shipments amounting to 80,429 boxes. This reduced the stocks considerably, and there are 17,000 boxes less in stock now than there were in last week. Prices are firm. Coke sheets 13s. 6d. to 14s. according to brand. Bessemer best brands rule at 14s.; Siemens, 14s. 3d. to 14s. 6d.; coke wasters, 12s. 6d. to 12s. 9d. Charcoal sheets are dull, and prices range from 15s. 6d. to 17s. 6d.

I cannot quite reconcile the activity in exports and firmness of prices with the unsatisfactory feeling prevailing amongst makers. Possibly they regard the late spurt as meaning little. The collapse of three large works shows that there are grave difficulties in the way, and that "weeding out the weak ones" may be expected.

Kirkhouse's "harbour" for collieries is being widely discussed in the coal pits amongst the men, and the only fear expressed is that the force of an explosion may demolish a lamp station, or harbour. I do not think this argument sound. Is it not a fact that lamp stations remain invariably intact? I see in the Bristol coalfield this week an explosion occurred, four being killed and many injured by the after-damp.

ENGINEERING SOCIETY, KING'S COLLEGE, LONDON.—At a general meeting held on Tuesday February 9th, the President in the chair, Mr. Heathcote read a paper on "Water-motors." The author commenced by enumerating the various forms of water-wheels, overshot, undershot, and breast. He then passed on to consider reaction wheels, under which head Whitelaw's improved turbine was discussed. Turbines were next dealt with, the many kinds of inward, outward, and downward flow machines being explained and illustrated with diagrams. The best metal for the blades was discussed, the lecturer stating that cast iron was generally employed, though some makers preferred wrought iron or tin-plate. The great advantages claimed for turbines were that they occupied less space and required less attention than steam engines. Water engines next occupied Mr. Heathcote's attention. Westcott's peculiar engine was described, and also the invention of Sir William Armstrong, whereby the water engine was made double-acting. A water-wheel was also mentioned whose efficiency did not diminish with the supply of water. After a short discussion the meeting terminated. At a general meeting held on Tuesday, February 16th, the President in the chair, Mr. Saunders read a paper on "Dynamos." The author commenced by defining a dynamo-electric machine. He then reviewed the various methods of winding, referring especially to the principles and effect of shunt winding, and also explaining the combination of series and shunt coils to obtain constant difference of potential. Mr. Saunders next described the different machines in use, taking in turn several well-known types, and pointing out the merits and details of construction of each. The author dwelt at some length on the Edison-Hopkinson dynamo, noticing particularly the improvements which it embodies, both electrically and mechanically, on its American prototype. The dynamos of the following were also described, Siemens, Crompton, Kapp, Gramme, Brush, Shuckert-Mordey, Weston, Paterson and Cooper, Joel, Parker-Elwell, Thomson-Houston, Hochhausen, and Hopkinson's Manchester dynamo. The paper was profusely illustrated with diagrams clearly setting forth the various methods of winding, and the shape, disposition, and relative magnitude of the parts of the various machines.

NEW COMPANIES.

THE following companies have just been registered:—

Oswald and Co., Limited.

This is the conversion to a company of the business of Oswald, Mordaunt, and Co., shipbuilders and engineers, of Woolston, near Southampton. It was registered on the 12th inst. with a capital of £317,500, in £10 shares, whereof 13,000 are £7 per cent. cumulative preference shares. An agreement of the 30th ult. regulates the purchase, the consideration being £217,500, payable £30,000 in cash, and the balance in fully-paid shares. The company will purchase at cost price certain materials, unworked iron, timber, stores, &c., and also all work done or material used for ships and works in progress. The vendors agree to erect and place two patent hauling-up slips, one sufficient to carry ships up to 3000 gross tonnage, and the other ships of moderate tonnage, in consideration of which they will be entitled to one-half of all sums subscribed for the first 10,000 preference shares, but provided 10,000 preference shares shall not be allotted, one equal half-part of those which remain unallotted will be issued to the vendors or their nominees as fully-paid. Each of the vendors is appointed a managing director for five years. The salaries of the managing directors will be as follows:—To Mr. Thomas Ridley Oswald, £2625; and to Mr. John Murray Mordaunt, £1125; and they will be further entitled to a commission of 15 per cent. upon the amount of dividend upon the ordinary shares in any year, provided such commission does not exceed £1250 per annum. The subscribers are:—

	Shares.
*T. Ridley Oswald, Southampton, shipbuilder	1
*J. M. Mordaunt, Southampton, shipbuilder	1
G. H. Hall, 8, Warwick-court, Gray's-inn, solicitor	1
*H. Hankey, 67, Elm Park-gardens, S.W.	1
*R. Revett, 28, Eaton-rise, Ealing, director of the Royal Mail Company	1
W. J. Stilwell, 3, Lothbury, clerk	1
John Cartwright, 15, Carlyle-road, Ilford, clerk	1

The maximum number of directors is to be eight, and the minimum three; qualification, shares or stock of the nominal value of £250; the first are the subscribers denoted by an asterisk and Messrs. George Henty and Charles Hay Stewart. Each ordinary director will be entitled to £100 per annum, and a further sum of £100 will be set aside for such director, and the total amount of such sums will be divided amongst the members of the board in proportion to their respective attendances at board and committee meetings.

Manchester and Liverpool Carrying Company, Limited.

This company was registered on the 12th inst. with a capital of £10,000, in £5 shares, to carry goods between Manchester and Liverpool, by water and by other means. The subscribers are:—

	Shares.
W. Delany, 16, Cumberland-street, Manchester, maker-up and packer	1
J. Delaney, 16, Cumberland-street, Manchester, clerk	1
J. A. Birch, Sale, Cheshire, bookkeeper	1
E. Nicholson, Fenwick-chambers, Liverpool, shipbroker	1
J. R. Straus, Prestwich	1
F. J. Lucas, 11, York-street, Manchester, accountant	1
H. A. Schank, Fenwick-chambers, Liverpool, broker	1

Registered without special articles.

Old Swan Borax Company, Limited.

This company proposes to take over the business of borax manufacturer carried on by Mr. Ernest Laremont Fleming, at the Old Swan, Liverpool. It was registered on the 15th inst. with a capital of £50,000, in £1 shares. The subscribers are:—

	Shares.
*Duncan McWatty, 1, Water-street, Liverpool, merchant	1
*Allan J. Smith, 2, Oriel-chambers, Water-street, Liverpool, merchant	1
*J. M. Levy, 59, Fenchurch-street, merchant	1
*E. L. Fleming, Wavertree, manufacturer	1
J. Dean, 22, Lord-street, Liverpool, solicitor	1
T. T. Irvine, Old Hall-street, Liverpool, merchant	1
F. S. Elsworth, Fazakerley, accountant	1

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

Hirsh, Greystock, and Co., Limited.

This is the conversion to a company of the business of portable electric light manufacturers, carried on by Mr. Walter Moser, trading as Hirsh, Greystock, and Co., at 11, Queen Victoria-street. It was registered on the 15th inst. with a capital of £50,000, in £10 shares. The subscribers are:—

	Shares.
Henry Peter Bernard, 107, Cannon-street, accountant	1
T. B. Reynolds, Addiscombe, manager to a solicitor	1
A. C. Bell, 22, St. John's-grove, Croydon, clerk	1
W. Moser, 11, Queen Victoria-street, electrician	1
C. J. Reeder, 45, Fonthill-road, Tollington Park, accountant	1
G. J. Carringham, 21, Gilmour-road, Lewisham, electrician	1
R. T. Linford, Rosedale-place, Ealing, secretary to a company	1

The number of directors to be not less than two before allotment, nor more than six; qualification for directors other than the first, £500 in shares; remuneration, £850 per annum. The subscribers are to appoint the first directors.

Aspriéres Silver Lead Company, Limited.

Upon terms of an agreement of the 16th inst., this company proposes to purchase from the Rev. P. Bennett Power a concession from the French Government, dated 8th of September, 1884, in relation to mines of copper, zinc, argentiferous lead, and other metal connected therewith, situated in the communes of Aspriéres and Bouillac Aveyron, in France. It was registered on the 15th inst. with a capital of £50,000, in £1 shares. The purchase consideration is 30,000 fully-paid shares, 171 B debentures of £100 each, and 57 C debentures of £100 each. The subscribers are:—

	Shares.
Rev. P. B. Power, West Heath House, Hampstead, common, Surrey	1
G. H. Fryer, 107, Belsize-road, South Hampstead	1
W. H. Jones, 56, Chesterfield-grove, East Dulwich, accountant	1
E. Hill, 19, Orchard-road, Highgate, accountant	1
A. T. Brown, 85, Hornsey Park-road, accountant	1
R. H. Everitt, 585, Commercial-road, clerk	1
F. W. Everitt, 142, Dalston-lane, clerk	1

The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £500 in shares or stock; the company in general meeting will determine the remuneration of the board.

Simplex Electrical Syndicate, Limited.

This company was registered on the 15th inst. with a capital of £6000, in £50 shares, to acquire and work the following letters patent:—No. 3901, dated 25th Feb., 1884; No. 15,030, dated 14th Nov., 1885; No. 7390, dated 17th June, 1885, for improvements in electric arc lamps; and No. 12,840, dated 26th Oct., 1885, for improvements in secondary batteries. The subscribers are:—

	Shares.
C. L. Wingfield Fitzgerald, 4, Hercules passage, Threadneedle-street, stockbroker	5
A. H. Baker, 31, Throgmorton-street, stockdealer	5
W. W. Bateman, Cornhill-chambers, merchant	5
R. E. Bateman, North View, Reigate	5
F. C. Stoop, 46, Penywern-road, Earl's-court, stockbroker	5
H. Grewing, 26, Queen Anne's-gate, merchant	5
H. B. Muir, 192, Cromwell-road, merchant	5

Registered without special articles.

Patent Pavement Light Company, Limited.

On the 16th inst. this company was registered with a capital of £6000, in £1 shares, to acquire and work the letters patent granted to Robert Wilson for the improvement in lenses for pavement reflectors, deck lights, and other like uses. The subscribers are:—

	Shares.
Hy. Harker, 37, Walbrook, public accountant	25
E. James, 11, Staple-inn, surveyor	25
T. Wilson, Wallsend	25
S. Lowe, 182, Strand, journalist	20
T. Teasdale, 11, King William-street, iron merchant	25
J. H. Biddles, 23, Brixton-road, clerk	10
Wm. Young, 26, Southwark-street, hardware merchant	10

Registered without special articles.

Wilson's Patent Company.

This company proposes to acquire the British and Foreign patent rights of Mr. Alexander Wilson, for improvements in the manufacture of armour-plates. It was registered on the 13th inst. as an unlimited company with a capital of £14,000, divided into 140 shares of £100 each. The subscribers are:—

	Shares.
Alexander Wilson, Sheffield, steel manufacturer	1
M. Pearce, Linnet-lane, Liverpool, merchant	1
Hy Wilson, Dundee, merchant	1
W. Lester, Glasgow, merchant	1
B. E. Cammell, Sheffield	1
A. L. Cammell, 29, Bury-street, St. James'	1
C. E. Vickers, Sheffield, solicitor	1

The management of the business will be vested in the company in general meeting, and in such officers or committee of members as may be appointed at any such meeting.

Gas and Light Company of Portugal, Limited.

This company proposes to acquire concessions or contracts for lighting towns or other places in Portugal, the Portuguese Possessions or elsewhere, with gas, electric light, or other illuminant. It was registered on the 16th inst. with a capital of £100,000, in £5 shares. An unregistered agreement of the 11th inst., between R. F. Holland (for this company) and the Gas and General Works Company, Limited, is adopted. The subscribers are:—

	Shares.
Hy. Cade, 19, Runton-street, Holloway, clerk	1
G. Pye, 2, West View, Hendon, architect	1
A. Stein, 17, Great Winchester-street, secretary to a company	1
F. J. Jones, 257, Uxbridge-road, engineer	1
F. Howell, Dunstable, broker	1
F. O. Moore, 10, Adelphi-terrace, journalist	1
H. O. Moore, Addlestone, Surrey, barrister	1

The number of directors is not to be less than three nor more than seven; qualification, twenty shares; the first are the Hon. Wm. Annand (late Premier of Nova Scotia), Sydenham; Richard Wood, J.P., Sydenham; and W. Fletcher Gordon, 12, Montagu-street, Portman-square. The remuneration of the board will be £500 per annum, with an additional sum of £200 for each concession taken over by the company after the first.

Flax and Paper Company, Limited.

This company proposes to purchase freehold land with factory, situate at Scole, Norfolk, and to grow flax and other products, and to use the factory and premises as flax and paper mills, or for other industrial purposes. It was registered on the 12th inst. with a capital of £20,000, in £5 shares, with power to increase to £250,000. The subscribers are:—

	Shares.
*R. Cook Laird, 9, Margaret-street, Stamford-hill, corn merchant	1
R. G. Chapman, 5, Bouverie-terrace, Stoke Newington, clerk	1
C. Turner, 73, Dynevor-road, Stoke Newington, engineer	1
*C. Heigham, 1, Louise Villas, Leyton, mortgage broker	1
*F. J. Archer, 484, Barking-road, Plaistow, engineer	1
F. T. Archer, Alma-road, Ponder's End, engineer	1
C. Wright, 8, Stretton Villas, Gascoyne-road, South Hackney, butcher	1

The number of directors is not to be less than three nor more than ten; qualification, £250 in shares or stock; the first are the subscribers denoted by an asterisk. Mr. W. Goulton, of Scole, Norfolk, the founder of the company, is appointed general manager and permanent director. The company in general meeting will determine the remuneration of the ordinary directors.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

16th February, 1886.

2214. SPRINGE HINGE, R. H. Hayhurst.—(*T. C. Longbottom, United States.*)
2215. SPOOL-WINDING MACHINERY, J. Heal, Halifax.
2216. WASHING PHOTOGRAPHIC PLATES, A. Anderson, Elgin.
2217. HEMISPHERICAL PIGEON TRAP, W. Dodge, Steeple Claydon.
2218. CRUCIBLE STEEL PLOUGH, D. and J. Hally, Auchterarder.
2219. CINDER RIDDLER, B. Fletcher and S. Cheetham, Southport.
2220. DRAWING-OFF ROLLERS, A. and W. Kendall, Halifax.
2221. PULPING FIBRES for MAKING PAPER, T. Rowland, Halifax.
2222. THREAD GUIDE, J. H. Bower.—(*M. C. Rutnagur, India.*)
2223. REVERSIBLE, &c., HANDLED BRUSH, A. W. Preston, Huddersfield.
2224. SLIDE for EXPOSING SENSITIVE FILMS, W. Middlemiss, Bradford.
2225. FANS, A. W. McComas and H. A. Fitzhugh, London.
2226. CARBONISING VEGETABLE MATTER, J. P. Land and C. P. Ring, London.
2227. CALENDERS, E. Marshall, Manchester.
2228. REGULATING GAS, &c., COCKS as BYE-PASS COCKS, S. Napper, London.
2229. CORSETS, W. W. Popplewell.—(*Mrs. I. Karp, United States.*)
2230. STOCKING SUSPENDERS, M. A. Withey, Lymington.
2231. CARTRIDGES, S. H. Emmens and J. O. Byrne, London.
2232. PORTABLE CANS, &c., H. Lees, Ashton-under-Lyne.
2233. EXTRACTION of SALTS, M. R. Pryor, Stevenage, and A. C. Jameson, London.
2234. SMOOTHING IRON, R. W. Thomas and P. C. Smith, London.
2235. CISTERNS for WATER-CLOSETS, &c., W. Farley, London.
2236. FIRE EXTINGUISHER, J. Wainwright and H. Briggs, London.
2237. PRESERVING ALCOHOLIC LIQUIDS, &c., T. Bowen, London.
2238. TOBACCO PIPES, &c., F. Weaver, London.
2239. TREATING STAVES, J. Hawley and S. Lord, London.
2240. WATER WASTE PREVENTER, F. S. Winser, London.
2241. CYLINDERS for MUSICAL BOXES, J. Manger, London.
2242. ELECTRO-STYLO-AUREO-GRAPHIC PEN, C. A. Teske, London.
2243. ORNAMENTING ROUGH, &c., SURFACES, J. Budd, London.
2244. SOAP, H. F. Ihlee.—(*W. Benger and Sons, Germany.*)
2245. MAKING PACKING CASES, &c., R. O. Ritchie, London.
2246. GERMINATING APPARATUS, L. Schonjahn, Glasgow.
2247. LAMPS. J. W. B. Wright, London.
2248. CLOCK, W. Soutter, London.
2249. PORTABLE FORGES, W. Allday, London.
2250. CHAIRS, W. P. Thompson.—(*G. F. Child, United States.*)
2251. SAWS, A. J. Boult.—(*A. Bertram, Canada.*)
2252. METALLIC CASKS, L. Doullet, Liverpool.
2253. FLUID METERS, A. J. Boult.—(*D. A. Sutherland, United States.*)
2254. BOOTS and SHOES, A. Rabow, Liverpool.
2255. WATER-METERS, L. H. Nash, London.
2256. WATER GAUGES for MARINE BOILERS, &c., J. Cameron, Liverpool.
2257. PROPORTIONAL WATER-METERS, L. H. Nash, London.
2258. AUTOMATIC GAS GENERATORS and GOVERNORS, O. W. Bennett, London.
2259. KNIVES, &c., for BOOT CHANNELING MACHINES, W. Podbury and M. H. Pearson, London.
2260. FEED-WATER PURIFIERS for LOCOMOTIVE ENGINES, H. J. Haddan.—(*J. T. Mead and J. Thomson, U.S.*)
2261. OCTAVE COUPLERS for ORGANS, W. Murphy, London.
2262. MEASURING APPARATUS for LIQUID CARBONIC ACID, E. Luhmann and C. G. Rommenhöller, London.
2263. RANGE FINDERS for MEASURING DISTANCES, C. C. Cole, London.
2264. REPRODUCTION of PICTURES, &c., C. C. Cole, London.
2265. METAL PLATE for KITCHEN FENDERS, &c., P. J. Webb, London.
2266. SCISSORS or SHEARS, A. F. Sanderson, London.
2267. BRAKES for VEHICLES, J. Y. Johnson.—(*G. Armstrong, U.S.*)
2268. TRANSMITTING SPEECH and other SOUNDS, C. A. Bell, London.
2269. PREVENTING WATER-PIPES BURSTING by FROST, W. Payton, London.
2270. COAL-GAS, A. Kitt, London.
2271. MAKING RUGS, P. A. Newton.—(*C. A. Ludlow and A. R. Lacey, United States.*)
2272. SUPPLY VALVE GEAR for GAS ENGINES, H. H. Leigh.—(*J. Spiel, Germany.*)
2273. MUSIC DESKS, &c., W. F. B. Massey-Mainwaring, London.
2274. PROCESS for PLATING IRON or STEEL, H. R. Cassel.
2275. LOCKS, A. M. Clark.—(*J. A. and G. W. Murray, United States.*)
2276. COATING METALS with LEAD, &c., A. Eckarpt, London.
2277. APPARATUS for INDICATING the LEAKAGE of WATER from PIPES, H. H. Lake.—(*L. Weil, United States.*)
2278. BOILERS for USE in the MANUFACTURE of PAPER PULP, H. H. Lake.—(*C. E. Ball, United States.*)
2279. REFRIGERATORS, H. H. Lake.—(*E. E. Hendrick, United States.*)
2280. FARE-REGISTERING APPARATUS, H. H. Lake.—(*E. Headley, United States.*)
2281. DEVICE for USE in GAMES with MARBLES, H. H. Lake.—(*F. H. Voigt and B. Delitsch, United States.*)
2282. SEPARATING MAGNETIC from NON-MAGNETIC SUBSTANCES, H. H. Lake.—(*H. Kessler, Germany.*)
2283. MAGAZINES, H. H. Lake.—(*The Winchester Repeating Arms Company, Incorporated, United States.*)
2284. EXHIBIT CASES, F. H. Judson, London.
2285. EXTRACTING MECHANISM for GUNS, T. Nordenfelt, London.
2286. LOCKS, A. Schanschieff, London.
2287. MACHINERY for TREATING COCOA-NUT FIBRE, J. H. Vavasseur, London.
2288. DIRECTING the FLIGHT of ROCKETS, J. R. Dry, London.

17th February, 1886.

2289. MORTICE LOCK FURNITURE in EARTHENWARE, H. G. Hesketh, Burslem.
2290. ELECTRIC TESTING APPARATUS, J. S. Raworth, Manchester.
2291. ATTACHMENTS for FLEXIBLE METALLIC MATTRESSES, G. and E. Woods, Liverpool.
2292. CONSTRUCTION of STEAM ENGINES, J. S. Raworth, Manchester.
2293. UNBREAKABLE CRICKET BATS, W. B. Gasson, Southborough.
2294. FASTENERS for DRIVING BELTS, I. Jackson, Manchester.
2295. LOCOMOTIVE STEAM ENGINES, T. Hunt, Manchester.
2296. AUTOMATIC TILT for CASKS, W. A. and J. Colligan, Coventry.
2297. PNEUMO THERAPEUTIC APPARATUS, W. J. Poole, Acton.
2298. PRESSING, &c., GRASS, A. C. Smethurst, Manchester.
2299. REGULATING ADMISSION of GAS to BURNERS, H. Fourness, Manchester.
2300. WELL SPONGE BATH, A. W. Darley, Southsea.
2301. RESERVOIR PEN, S. and J. Morgan, Birmingham.
2302. WATER-CLOSETS, &c., B. R. Phillipson, Dublin.
2303. CONTROLLING, &c., FLOW of LIQUIDS, H. Sutcliffe, Halifax.
2304. WHEELS of VEHICLES to RUN on GROOVED RAILS, &c., G. F. Priestley, Halifax.
2305. BALL VALVES, B. G. Smith, Halifax.
2306. MINERAL OILS for TOILET PURPOSES, P. M. Crane, G. Moir, and S. Washington, London.
2307. COKE for METALLURGICAL PURPOSES, H. Barclay and R. Simpson, Cumberland.
2308. PROTECTING MUSICAL COMPOSERS, E. Wright, Northampton.
2309. SPEED GOVERNORS for MOTIVE-POWER ENGINES, D. D. and W. D. Napier, Glasgow.
2310. PIGMENTS, D. Swan, Glasgow.
2311. CARDBOARD, &c., BOXES, J. M. Baines, Manchester.
2312. STEAM ENGINES, S. S. Yen, Newcastle-on-Tyne.
2313. COMMUNICATING between TRAINS and POINTS and SIGNAL CABINS on RAILWAYS, J. Sharp and A. Ambler, Bradford.
2314. CYLINDER PRINTING MACHINES, F. Payne, Halifax.
2315. GAS ENGINES, H. S. Moore, Sheffield.
2316. PICKERS for LOOMS, J. Kershaw and H. Hodgkinson, London.
2317. ELECTRICAL SWITCHES, C. Browett, London.
2318. SHOVELS, J. Lee, Birmingham.
2319. DISSOLVING AMBER, T. Terrell, London.
2320. PHANEROGRAPHIC PRINTING, J. W. Middleton, London.
2321. ROTARY BLOWERS, F. J. Candy, London.
2322. METALLISING WOVEN TEXTILE FABRICS, L. A. Groth.—(*U. R. Pumariega, Spain.*)
2323. PROTECTING and SECURING PINS, H. Brockelbank, Streatham.
2324. BUTTON, W. C. Pollock, London.
2325. STAMP with DIE for FASTENING BUTTONS, W. C. Pollock, London.
2326. WATER-CLOSETS, R. Rae, London.
2327. FINISHING BLOCK for HATS, A. H. Reed.—(*C. E. Keator, U.S.*)
2328. BOOTS and SHOES, J. B. Rogers, London.
2329. HATS, W. P. Thompson.—(*J. A. Ledru, France.*)
2330. ROTARY ENGINES, C. P. Jürgensen, London.
2331. DEVICES for ADVERTISING, &c., C. Wraa, London.
2332. EMBROIDERING MACHINES, E. Cornely, London.
2333. LAMP for HEATING, &c., PURPOSES, H. Gadiffert, London.
2334. SPRING MATTRESSES and COVERINGS for SEATS, &c., W. F. Thomas, London.
2335. ANHYDROUS SULPHURIC ACID, R. H. Wilson, London.
2336. ADVERTISING, G. F. Redfern.—(*P. Gomord, France.*)
2337. LATCHES, R. G. Lacey, London.
2338. PROPELLING MECHANISM, W. L. Wise.—(*F. F. von Palstring, Germany.*)
2339. STOPPERING of BOTTLES, C. Cheswright, London.
2340. BROOMS and BRUSHES, H. G. Govier, London.
2341. GLOVES, H. Urwick, London.
2342. HOLDING ARTICLES in SHOP WINDOWS, J. Lakeman, London.
2343. CLIPS for HOLDING NECKTIES, &c., J. Lakeman London.
2344. PROTECTING PARTS of TROUSERS from WEAR, J. Lakeman, London.
2345. CONNECTING TOGETHER VARIOUS ARTICLES, B. Cars, London.
2346. FILTERING COOLER WORT, F. Faulkner, Oldbury.
2347. CORNICES of IRON BEDSTEADS, L. Brierley London.
2348. TELEGRAPH POLES, &c., D. Wilson, Grays.

18th February, 1886.

2349. LUBRICATING AXLE JOURNALS, T. Phillips, London.
2350. STOPPERS for BOTTLES, J. B. Adams and T. W. Duffy, Liverpool.
2351. WINDOW FASTENINGS, G. W. Pridmore and G. Wakeman, Birmingham.
2352. HANGING MEAT, &c., in a LARDER, C. Weaver, London.
2353. SIGHT FEED and other LUBRICATORS, J. Lumb, Halifax.
2354. FLOUR, E. Scholes, Manchester.
2355. BREAKING GRAIN, C. and J. D. Tomlinson and J. Porter, Manchester.
2356. PROTECTING the TOE-PARTS of BOOTS, &c., J. Hewitt, Leicester.
2357. TOY WASHING MACHINES, G. Smith, Birmingham.
2358. PORTABLE STOVE, G. Johnson, Manchester.
2359. STEAM PACKINGS, C. Moseley, Manchester.
2360. THREAD WINDING MACHINES, J. M. Cryer and J. T. Wibberley, Bolton.
2361. COURT MARKER for LAWN TENNIS, &c., C. G. Gill, Gravesend.
2362. PICKING MOTION of LOOMS, J. and E. Horrocks, Bradford.
2363. DRAWING CORKS from BOTTLES, T. E. Town, Bradford.
2364. MINERS' SAFETY LAMPS, A. Howat, Manchester.
2365. PHOTOGRAPHIC CAMERAS, C. D. Durnford, London.
2366. CARDING ENGINES, F. Wilkinson, Manchester.
2367. SECURING RAILS in RAILWAY CHAIRS, J. Harrison Careby, near Stamford.
2368. PREVENTING BOATS CAPSIZING, E. S. Swainson, Old Farleigh.
2369. FRICTIONAL CLUTCHES, D. D. and W. D. Napier, Glasgow.
2370. PHOTOGRAPHIC APPARATUS, W. Rogers, Liverpool.
2371. CHIMNEY TOPS, &c., E. P. Houghton, Liverpool.
2372. ELECTRO-MAGNETS, T. B. Grant, London.
2373. POWER HAMMERS, J. Wild, Chadderton.
2374. DOOR CHAIN, C. Groombridge and J. P. Rickman, London.
2375. WHEEL TIRES, W. Fox, London.
2376. PREVENTING INCRUSTATION in STEAM BOILERS, S. Fox, London.
2377. REGULATING GAS LIGHTS in RAILWAY TRAINS, W. B. Rickman, London.
2378. ELECTRIC BELLS, S. A. Varley, London.
2379. TAPE, E. B. Hamel, I. Lunn, and W. Hewitt, London.
2380. CUTTING, &c., CIRCULAR BRUSHES, W. Philipson, London.
2381. HOT-AIR HEATING APPARATUS, S. Widdows, London.
2382. AUTOMATIC FIRE-EXTINGUISHING SPRINKLERS, R. Dowson and J. Taylor, London.
2383. TICKET RACKS, &c., S. Camm and J. Leach, Sheffield.
2384. PHOTOGRAPHIC SHUTTERS, C. D. Durnford, London.
2385. STANDS for SEWING MACHINES, &c., H. Kinsey, Swansea.
2386. COMPOUND MARINE STEAM ENGINES, G. A. P. H. Duncan, London.
2387. SEPARATING FOREIGN SUBSTANCES from BEANS, C. A. Baxter, London.
2388. LAMPS, E. A. Rippingille and H. Priest, London.
2389. SUSPENSION LAMPS, E. A. Rippingille, London.
2390. CARRIERS used in PHOTOGRAPHY, F. J. Vergara, London.
2391. COUPLINGS for RAILWAY WAGONS, W. Dryden, Glasgow.
2392. CLEANING SHIPS' BOTTOMS, J. Spencer, Glasgow.
2393. SEWING MACHINES, A. Anderson and R. A. F. Pollock, Glasgow,

2394. DIES, T. R. Bayliss, London.
2395. STEAM BOILERS, R. H. Taunton, London.
2396. ROCKING-HORSES, W. T. Jaques and G. B. Lovedee, London.
2397. RAILWAY KEYS, A. Denuit and L. H. O'Meara, London.
2398. HYDROCARBON MOTORS, E. Capitaine and F. Brünler, London.
2399. MIXING CONCRETE, H. Faija, London.
2400. BREECH-LOADING FIRE-ARMS, K. Krnka and T. Sederl, London.
2401. LOCK-NUTS, G. Turton, London.
2402. RECOVERY of TIN, H. H. Lake.—(*Verein Chemischer Fabriken, Germany.*)
2403. OPERATING ELECTRIC SMELTING FURNACES, H. J. Haddan.—(*E. H. Cowles and A. H. Cowles, U.S.*)
2404. EFFECTING INDUSTRIAL DESICCATION, G. M. Capell, London.
2405. LOCKING DEVICES for SCREW-NUTS, H. H. Lake. —(*L. Véron, France.*)
2406. VERTICAL STEAM BOILER, F. C. Simpson, J. B. Denison, and E. F. Denison, London.
2407. HORSESHOES, G. Urquhart, London.
2408. REFRIGERATING MACHINES, H. A. Fleuss, London.
2409. RAILWAY COUPLINGS, W. W. Hewitt and W. F. Goreham, London.
2410. LECLANCHE BATTERY, A. Lévy, London.
2411. CENTRE VALVES for WORKING PURIFIERS, A. Dempster, Elland.
2412. PURIFYING COAL-GAS, A. Dempster, Elland.

19th February, 1886.

2413. SAFETY GEAR for LIFTS, J. Williams and A. Meldrum, London.
2414. SECURING the HANDLES, &c., of KNIVES, B. Rodgers, Sheffield.
2415. REGULATING SPIRIT LAMP, G. H. Bird, Aston.
2416. LITHO and LETTERPRESS PRINTING MACHINES, G. Newsum and H. K. Ashwell, Bradford.
2417. PRODUCING ASTRACHAN YARN, J. Howgate and Sons and F. Smith, Bradford.
2418. RAILWAY, &c., ALARM SIGNALLING, E. Foulger, Liverpool.
2419. FIXING DOOR HANDLES to SPINDLES, J. Hicken, Landport.
2420. MARKING APPARATUS of SIZING MACHINES, J. Butterworth and W. Dickinson, Halifax.
2421. BOTTLE CASE DIVISION, G. Perry, Dublin.
2422. PRESSES, J. P. Jackson, Liverpool.
2423. STANDS for PHOTOGRAPHIC CAMERAS, A. Rayment, London.
2424. HANDLES for TRAVELLING BAGS, A. Timpé, Manchester.
2425. SOCKETS for METAL ROPES, W. C. Blackett, Kimblesworth.
2426. PUMPS, J. Moore, Glasgow.
2427. DOOR LOCK and LATCH FURNITURE, W. Sanderson, Birmingham.
2428. CURTAIN RINGS, W. J. Tanner, London.
2429. GOVERNORS for STEAM ENGINES, R. Wilding, Manchester.
2430. DRILLS, J. Deacon, Birmingham.
2431. PUTTING ON BUTTONS, W. Kruppeit, London.
2432. HORSESHOES to PREVENT SLIPPING, G. H. Ellis, London.
2433. DYNAMO-ELECTRIC MACHINES, &c., T. A. Garrett, London.
2434. MULES and TWINERS, G. Pickford and E. Jagger, London.
2435. BRUSHES, J. Raper, M. Pearson, and F. Gill, London.
2436. CORSET FASTENINGS, J. Gesche and Messrs. Frank and Herz, London.
2437. DIFFERENTIAL GEARING for DRIVING AXLES, E. Burstow, London.
2438. LETTERPRESS PRINTING MACHINES, D. Carlaw, Glasgow.
2439. TREATING SEWAGE, F. H. Danchell, London.
2440. MARKERS for LAWN-TENNIS COURTS, T. W. Goddard, London.
2441. PUMPS, G. Melcher, London.
2442. PERAMBULATORS, A. Cornell, London.
2443. SPINNING FIBROUS MATERIAL, J. Monks and W. J. Redman, London.
2444. SPORTING COSTUME, E. T. Hughes.—(*M. J. A. Roffy, France.*)
2445. PREPARING FINELY DIVIDED METALLIFEROUS SUBSTANCES, W. Thomlinson, London.
2446. MOVABLE TARGETS, W. and H. Trotman, London.
2447. GAS ENGINES, J. Shaw, London.
2448. MECHANICAL MOULDING, A. E. and H. M. Butler, London.
2449. APRON for STREET VEHICLES, T. Young, London.
2450. PUMP for WASHING OUT the STOMACH, A. E. A. Ruault, London.
2451. LETTER BALANCE, E. M. H. Reimbold, London.
2452. REGULATING the SPEED of STEAM ENGINES, H. H. Lake.—(*E. H. Amet, United States.*)
2453. STOP VALVES, J. A. and J. Hopkinson, London.
2454. MACKINTOSH WATERPROOF CLOTH, A. Cunningham and J. W. Postlethwaite, London.
2455. POLE CRABS, G. Birch, London.
2456. HOLDERS for INCANDESCENT ELECTRIC LAMPS, J. Lee, London.
2457. HYDRAULIC VALVE, J. Bennie, Glasgow.
2458. SAFETY APPARATUS for HOISTS, J. Bennie, Glasgow.
2459. MAGIC LANTERNS, A. Wrench, London.
2460. COMPOSITION for STRAPS, &c., E. B. Petrie and A. S. Fox, Manchester.
2461. STEP for BICYCLES, J. C. V. Smith.—(*W. D. Doremus, United States.*)
2462. SAWING the BOILER TUBES of LOCOMOTIVE ENGINES, G. F. Redfern.—(*J. J. J. Sultz, Belgium.*)
2463. HEATING OVENS, &c., C. A. Clapham, Bradford.
2464. DRYING MACHINERY, W. A. Gibbs, London.
2465. INCREASING the USEFUL EFFECT of MACHINERY, C. Hoare, London.
2466. APPARATUS for FILTERING and HOLDING WATER, T. Elcoate, Liverpool.
2467. CASH or other CARRIERS, F. McIlvenna and W. Thompson, Liverpool.
2468. WATERPROOF GARMENTS, W. J. B. Kincaid, Liverpool.
2469. VENTILATING WATERPROOF GARMENTS, M. J. Roffy, Liverpool.
2470. ELECTRICAL LOCOMOTION APPARATUS, E. Julien, Liverpool.
2471. DRYING SLURRY MATERIALS, E. W. Collier, London.
2472. DESIDERATUM FILTER, C. I. C. Bailey, London.
2473. REGULATING SUPPLY of WATER, E. Reynolds, London.
2474. STOP-MOTIONS for LOOMS, C. D. Abel.—(*E. Viret and A. C. Pruvot, France.*)

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2475. WATCH-BOW FASTENING, H. Emanuel, Surbiton.
2476. FOOT WARMER, S. C. Garland, London.
2477. TESTING LUBRICATING OILS, T. Harrison, Arnside.
2478. MAKING STEAM GENERATORS, &c., A. Higginson, Liverpool.
2479. ELECTRIC CABLES, W. T. Glover, Manchester.
2480. REGULATING SUPPLY of GAS, A. Huxley, Liverpool.
2481. FEEDING BOTTLE, E. Fox, London.
2482. COATING METALS, W. Crow and W. Coley, Birmingham.
2483. DOOR LOCK HANDLES, T. I. Gray, Blyth.
2484. SHUTTLES for LOOMS, W. Worden and J. Booth, Halifax.
2485. ARM-HOLES, I. Frankenberg and J. Grounousky, Manchester.
2486. EARTHENWARE HORSE MANGERS, J. Whitehead, Halifax.
2487. COUPLING APPARATUS, J. and A. Lockett and W. Greenhalgh, London.
2488. REFRIGERATORS for COOLING LIQUIDS, R. Holden, Halifax.
2489. FASTENING PIPES, G. H. Openshaw, Manchester.
2490. ARM-HOLE and POCKET, A. Span and I. Kriegsfeld, Manchester.
2491. GULLIES, J. Simpson, Bradford.
2492. TOY PISTOL, T. Evans, Birmingham.
2493. LAMP, &c., APPARATUS, G. Asher and J. Buttress, Birmingham.
2494. SIGNALLING for FIRE-ENGINES, &c., F. E. Stuart, London.
2495. TRIPODS, C. A. Eskell, London.
2496. SELF-CLOSING TAP, R. Cole, Bristol.
2497. WALL COVERINGS, S. Fisher, London.
2498. HEATING WATER, G. Beard, Glasgow.
2499. WINDOW FRAMES, W. Howie and R. Henderson, Glasgow.
2500. OPENING CASEMENTS, &c., C. P. Kinnell and G. Rothnie, London.
2501. PRESERVING VEGETABLE MATTERS, D. Johnson and H. G. R. Davies, London.
2502. TURNING OVER the END of CARTRIDGE CASES, W. Lightwood, London.
2503. CENTRIFUGAL MACHINES for SEPARATING FLUIDS, J. Gray, Glasgow.
2504. ABDOMINAL BELT, J. Grinsted, London.
2505. LAMP BURNERS, L. Rollason, Birmingham.
2506. DISINFECTING SOAP, F. Hochuli.—(*E. Pollacsek and J. Elsner, France.*)
2507. FIRE-GUARDS, F. A. Messer and W. F. Thorpe, London.
2508. TIRES for BICYCLES, &c., J. Munro, London.
2509. DISCHARGING WATER from the HOLDS of SHIPS, W. Bean, London.
2510. COMBINED SCHOOL DESKS and SEATS, A. J. Boult. —(*W. Stahlschmidt and J. H. Mickler, Canada.*)
2511. STEAM BOILERS, A. J. Boult.—(*W. Cooke, Canada.*)
2512. FASTENINGS for DOORS, &c., A. J. Boult.—(*H. Hearne and H. J. Hearne, Canada.*)
2513. TELEGRAPHY, A. J. Boult.—(*B. B. Toye, Canada.*)
2514. WRITING COPY-BOOKS, G. W. Bullen, London.
2515. FALSE SHIRT FRONTS, W. Blenkiron and Son and P. Law, London.
2516. DRAWING-OFF AERATED, &c., LIQUIDS under PRESSURE from BOTTLES, T. H. Rushton, London.
2517. FILTERING MATERIALS, F. Candy, London.
2518. METAL FLOORINGS, A. W. Pocock and H. McColley, London.
2519. MUSICAL INSTRUMENT, J. H. Cole, London.
2520. INDICATING TEMPERATURE, &c., of CONFINED FLUIDS, J. Thomson, Cathcart, near Glasgow.
2521. HORSE-SHOES, A. Dobbin, London.

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2522. HYDROSTATIC MINING WEDGE, W. S. Shreeve, Shrewley, near Warwick.
2523. HANDLES, &c., for CARRYING PARCELS, &c., H. A. Done, Sutton Coldfield.
2524. CLEANING ROD for GUN BARRELS, C. J. O'N. Ferguson, Inverness.
2525. ELECTRIC CONDUCTORS, J. G. Parker, London.
2526. PROPELLING LIGHT VEHICLES, W. H. H. Muir, London.
2527. CURVE RANGER, H. H. Dalrymple-Hay, London.
2528. FEEDING ARRANGEMENT of LAMP BURNERS, W. Fletcher, Dover.
2529. OPEN-HEARTH, &c., FURNACES, T. Williamson, Mossend.
2530. CEMENTS for COATING SHIPS', &c., SURFACES, W. Welch, Portsmouth.
2531. WATER-CLOSETS, W. M. Egglestone, Stanhope.
2532. HOLDER for CUTTING TOOLS, L. Mills, North Shields.
2533. MAGIC LANTERN and other SLIDES, D. Sherlock, Dublin, and O. Boeddicker, Parsonstown.
2524. VALVE, D. Laurie, Glasgow.
2535. COMBINED DRIVING and STEERING GEAR, C. V. Boys, London.
2536. MINERS' SAFETY LAMP, H. Casey, Barnsley.
2537. ATTACHMENTS for ELEVATORS, W. Goodwin, Liverpool.
2538. PIANOFORTE ACTIONS, G. Richmond, London.
2539. SWINGING, &c., MOVEMENTS for LOOKING-GLASSES, S. Timings, Birmingham.
2540. STICK and UMBRELLA HANDLES, F. Stabler, Whitby.
2541. SPRING FUR BOA, H. Davis, London.
2542. METALLIC CHAIR BEDSTEADS, W. N. Biyett, London.
2543. CUTTING and PUNCHING TILES, &c., E. Birch, Manchester.
2544. MOUTH TUBES for DENTAL and other PURPOSES, T. W. F. Rowney, Derby.
2545. CROSS CHANNEL NAVIGATION, A. M. Haldane, Holyhead.
2546. INDIA-RUBBER-COATED WATERPROOF CLOTHS, W. Coulter, Manchester.
2547. SECURING KNOBS to LOCK SPINDLES, J. Sample and W. M. Ward, Blyth.
2548. PREVENTING the SLIPPING of LOCOMOTIVES, J. R. Dix, Corris.
2549. RACK for HOLDING FISHING-RODS, &c., J. J. Hardy, Alnwick.
2550. METALLIC WHEELS for TRAM-CARS, &c., T. Malleband, London.
2551. PORTABLE DUST-BINS, A. Roberts, London.
2552. SLEEPERS and FITTINGS for RAILWAYS, &c., W. Strapp, Red Hill, and G. Edwards, Thornton Heath.
2553. FEEDING APPARATUS for SEWING MACHINES, B. Hawerkamp.—(*Anthon and Soehne, Germany.*)
2554. LANTERNS for ELECTRIC ARC LAMPS, W. A. S. Benson, London.
2555. STEEL and IRON PLATES for BOILER FLUES, J. D. Ellis, London.
2556. CONVEYING, &c., SEWAGE SLUDGE, A. Hubbard and R. J. Beale, London.
2557. ELECTRO-DEPOSITING ZINC upon IRON, T. Fenwick, London.
2558. SEWING MACHINES, I. Nasch, London.
2559. BRACES, J. B. Scammell, London.
2560. TIN, &c., A. T. Davis, T. H. and D. Griffiths, London.
2561. PADDING with TEXTILE FABRIC SURFACES of PAPER, &c., D. T. Lee, London.
2562. PENCIL HOLDERS, G. H. H. Olrogge, London.
2563. CUTTING TOOLS for METALS, J. W. Newall, London.
2564. PROPELLERS for SHIPS, &c., W. L. Bovyer, London.
2565. GRINDING, &c., METALLIC CARDS, J. C. Mewburn. —(*La Société Grosselin père et fils, France.*)
2566. BRICKS and TILES, P. Bawden, London.
2567. FIRE-EXTINGUISHERS, T. Witter, London.
2568. SPRINGS for CLOCKS, &c., E. T. Darke, London.
2569. INDICATING the CONDITION of HOUSE DRAINS, A. Flint, London.
2570. PERMANENT WAY of RAILWAYS, &c., F. E. Baxter, London.
2571. BRAKES, W. Pearson, London.
2572. REGULATING PRODUCTION, &c., of GAS, W. Kemble, London.
2573. ROTARY STEAM ENGINES, C. W. Vollman, London.
2574. BLOTTING-PAPER, &c., G. F. Redfern.—(*L. Schleipen and J. W. Erkens, Germany.*)
2575. COOKING UTENSILS, D. Poznainski, London.
2576. FITTING INDIA-RUBBER RINGS to FORM PIPE JOINTS, W. Y. Baker and L. White, jun., London.
2577. GAS STOVES, H. Steven and J. Ramsay, Glasgow.
2578. POCKET CALENDAR, J. D. F. Andrew, London.
2579. BICYCLES, H. H. Lake.—(*G. Glover, U.S.*)
2580. VALVES, B. J. B. Mills.—(*D. F. A. Decaix, France.*)
2581. MACHINE and other GUNS, H. S. Maxim, London.

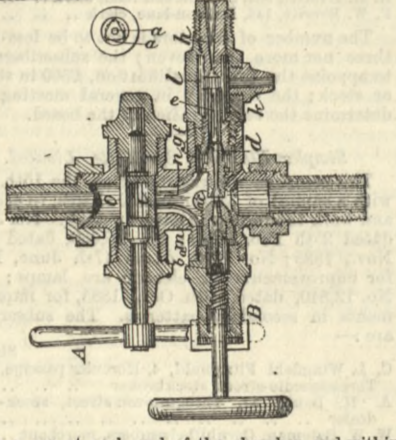
SELECTED AMERICAN PATENTS.

(*From the United States' Patent Office official Gazette.*)

333,534. INJECTOR, *Silas W. Moreland, Geneva, Ohio. —Filed February 24th*, 1885.

Claim.—(1) In an injector nozzle *a* provided with a transverse opening through it communicating with the bore of the nozzle and steam chamber *b*, combined with fixed nozzle a^1, and constructed with a triangular guide and conical valve at the end of the triangular section adapted to a concave seat in nozzle a^1, the point of nozzle *a* tapering and extending through nozzle a^1 into water chamber *c*, and entering within the throat of nozzle *d*, nozzle a^1 also extending into chamber *c*, but not into nozzle *d*, nozzles *a* and a^1 combined with water chamber *c*, nozzle *d*, steam chamber *g*, nozzle *f*, into the throat *e* of which the point of nozzle *d* enters, chamber *l*, tube *h*, and overflow *k*, and nozzles *a*, *d*, and *f* and tube *h*, aligned in a straight line with each other, and enclosed in a case provided with suitable connections for steam and water pipes, and all arranged, constructed, and operating as set forth. (2) In an injector, steam chamber *o*, provided

333,534



with a cap at each end of the chamber, and within and combined with said chamber valve *i*, provided with handle A upon a stem held in line in boxes in said caps, and a conical bearing adapted to a concave seat in the cap at the end of chamber *o*, next to handle A, said chamber *o* also provided with ports under valve *i*, and passages *m* and *n*, communicating with steam chambers *b* and *g*, combined with steam nozzles *a*, *d*, and *f*, tube *h*, and overflow *k*, all arranged, combined, constructed, and operating as set forth.

333,662. AUGER FOR CUTTING SQUARE HOLES, *William Patterson, San Francisco, Cal.—Filed April 20th*, 1885.

Claim.—(1) The combination of an auger *a* having two or more twists, and the feed or point coarse, and a rectangular cutting lip, chisels *q* surrounding said auger, and formed in right angle or straight, with their edges straight, convex, or concave, a hammer *c* having a vertical movement on the shank *b* of the auger to deliver a succession of blows upon an anvil, and the anvil *d*, to which the shanks of the chisels *q* are attached, the said movement of the hammer being produced in one direction by the rotation of the auger, and in the other direction by the spiral spring *l*, substantially as hereinbefore described. (2) In a mortising tool for cutting square holes, the combination of the auger or boring device, the cutting device formed of a chisel or chisels, a hammer having a vertical movement, and an anvil to which the chisels are attached, the said hammer being adapted to deliver a succession of blows upon the said anvil during the rotation of

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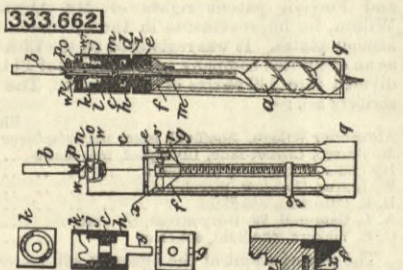
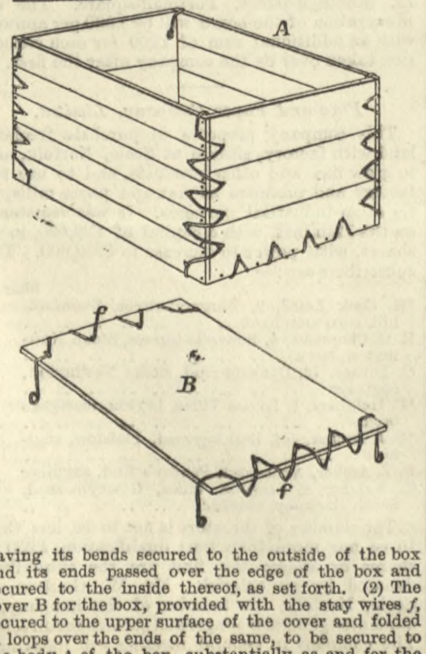


the auger, and the whole adapted to move on the auger shank, substantially as specified. (3) The combination of an auger *a*, chisels *q*, surrounding the auger blades, the hammer *c*, and anvil *d*, surrounding the auger shank, the guides *g* extending from the hammer, slots g^x for the passage of the guides, the spiral spring *l* engaging the hammer, cam *k*, regulating collar *m* of the auger stem, ratchet collar *n* arranged on the auger stem, the cam pin, pawl, and ratchets, and fixed collars *w* w^x on the auger stem, substantially as specified. (4) The combination of the separable, angular, or straight chisels *q* having pins, and holes *u*, to receive the pins to preserve true linear position of the chisels, and the clamp carrying a set screw to embrace and lock the chisel sections together and serve with an auger, substantially as specified. (5) The combination of a rotating auger *a* surrounding chisels *q*, the hammer *c*, and anvil *d*, arranged, respectively, on the shank of the auger, and the said hammer being operated by the rotary movement of the auger so as to deliver successive blows upon the said anvil to which the shanks of said chisels are attached, substantially as specified.

333,720. PACKING-BOX, *William H. Beach, Minneapolis, Minn.—Filed September 4th*, 1885.

Claim.—(1) As an improved article of manufacture, a packing-box having its corners stayed with a lacing wire passed back and forth across the corners, and

333,720



having its bends secured to the outside of the box and its ends passed over the edge of the box and secured to the inside thereof, as set forth. (2) The cover B for the box, provided with the stay wires *f*, secured to the upper surface of the cover and folded in loops over the ends of the same, to be secured to the body A of the box, substantially as and for the purposes set forth.

333,763. CONDENSER FOR STEAM ENGINES, *Robert Lees, Providence, R.I.—Filed September 29th*, 1885.

Claim.—(1) A steam condenser, consisting of a condensing chamber having a deflector, above and around which is disposed the perforated pipe coil of an injector, said deflector and injector both located near the exhaust port, and the base of said condensing chamber connecting with a valved eduction pipe passing through the cold water tank and into the hot water tank, all for the purpose described. (2) The

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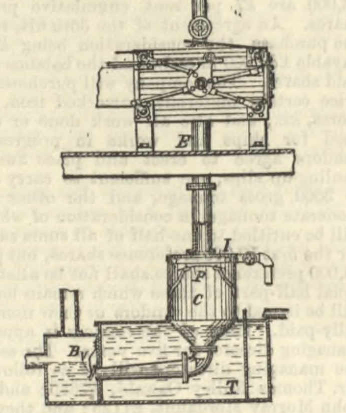

combination, with the exhaust pipe E of the condensing chamber C, having the deflector P, the injector I, and the eduction pipe V, provided with the valve *v*, and leading from the chamber C, through the tank T, into the tank B, for the purpose described.

333,805. SCREW PROPELLER, *Nicholas Yagn, St. Petersburg, Russia.—Filed May 15th*, 1885.

Claim.—(1) The combination of the propeller shaft having pivot pins *b* with the propeller hub mounted on said shaft to receive said pivot pins, the hub having a slot for the reception of the outer end of the shaft, substantially as set forth. (2) The combination of the propeller shaft having a spherical enlargement B, and pivot pins *b*, with a hub and an inclosing cap C^1, to fit said spherical enlargement and to receive the pivot pins, all substantially as set forth. (3) The combination of the propeller shaft, having pivot pins *b* and a bearing block E at its outer end, with a hub to receive the pivot pins, and having a slot D in which said

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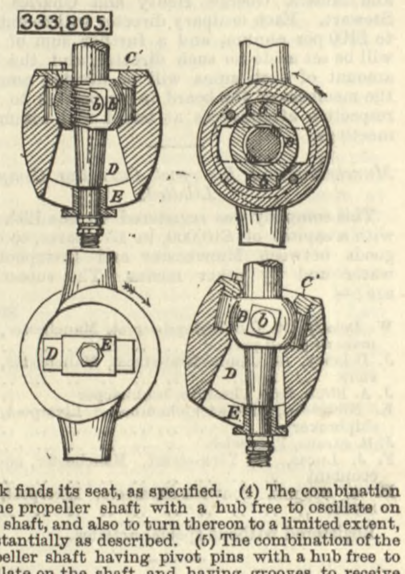

block finds its seat, as specified. (4) The combination of the propeller shaft with a hub free to oscillate on said shaft, and also to turn thereon to a limited extent, substantially as described. (5) The combination of the propeller shaft having pivot pins with a hub free to oscillate on the shaft, and having grooves to receive the said pins, substantially as specified. (6) The combination of the propeller shaft, having a boss carrying pivot pins, and bearing blocks on the pins, with a hub mounted on the shaft and having interior grooves, to which said blocks are adapted, substantially as set forth.

333,835. STEAM ENGINE GOVERNOR, *George H. Corliss, Providence, R.I.—Filed June 13th*, 1885.

Claim.—(1) The combination, with a speed governor for steam engines, of an anti-friction wheel Q arranged, as shown, relatively to the sleeve H, and adapted to

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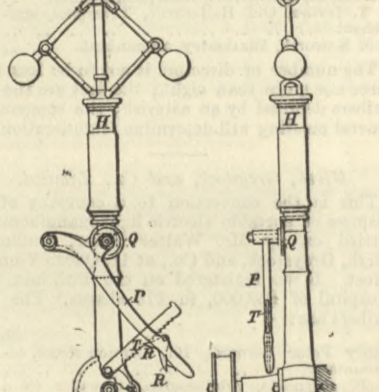

afford a frictionless bearing for said sleeve and hold the governor out of action when the speed is below a certain rate without imposing any appreciable friction, substantially as herein specified. (2) The combination with a speed governor for steam engines of the anti-friction wheel Q, lever P, spring-dog R, and ratchet bar T, arranged to serve as herein specified.